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REPAIR OF HERNIA OF THE DIAPHRAGM*

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HERNIA of the diaphragm is of interest to surgeons and clinicians alike, partly because of the spectacular event so often connected with its acquirement or its repair, and partly because of its rarity. Hedblom, in 1924, was able to find records of only 359 cases reviewed in the literature. To these he added nineteen cases from the Mayo Clinic bringing the total to 378. Since this report, eight other cases have been observed in the Clinic, making twenty-seven in all. It is probable that the total number of reported cases would represent only approximately half of the actual number, since the first two cases on record were reported by Ambroise Paré in 1610.

Hernias of the diaphragm are classified as congenital, acquired, traumatic and indeterminate. Thirty-seven cases were of congenital origin from defects in the closure of the diaphragm separating the thorax from the abdomen. This thin muscular structure is aponeurotic throughout its periphery, or tendinous throughout its centre, and with muscular contraction the dome of the diaphragm is brought down in the fixed chest, like a piston in a gas engine moving downward from the inrush of the air into the lung within the cylinder. One of the causes of such hernia in adults is rupture from a crushing injury, the body being forcibly depressed between the knees as from the caving in of dirt banks on the backs of ditch diggers. As I recall my early practice, some of which was in obstetrics, I well remember the efforts made to stimulate that first respiration in apparently stillborn or dead children. The efforts were usually successful, yet it is easily understood how rupture of the diaphragm could occur from such vigorous manipulations and how later it might appear that the rupture was of congenital origin, since the condition did not immediately cause symptoms.

From such efforts at resuscitation, complete atrophy of one or two of the leaves of tissue that form the diaphragm might then occur and the defect would appear to be of congenital origin, although occurring at birth. It is of interest that in some of the cases considered congenital no history of trauma during life sufficient to cause the defect has been recorded, a number of patients living to middle age and some to old age before symptoms develop. The most common traumatic causes of diaphragmatic hernia are stab wounds through the lower ribs, passing through the pleura and diaphragm; a con-

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siderable percentage of such cases have been followed by immediate prolapse of the omentum, and this has led to many operative closures of hernia of the diaphragm by exposure on the upper or thoracic side through the chest wall. Gunshot wounds have been the cause of a number of such hernias. Hedblom attributed war injuries as the cause in 127 of the 378 cases.

Only a few hernias have been noted as occurring at the site of the natural openings. Undoubtedly in many cases a weak point may occur on the left side of the oesophageal site in the diaphragm which permits the fundus of the stomach to flop back and forth through this opening without actually becoming a free hernia. The aponeurotic or fibrous structure of the central portion of the diaphragm is so thin and stretched at this point that it is difficult to remedy the condition. Although I have noticed the condition I have not felt that the symptoms were serious enough to warrant surgical intervention. On the right side the diaphragm is so well protected by the liver that it is seldom injured, and yet a few cases are reported with prolapse of the omentum into the right side of the chest. These openings may be small or they may be very large; the lung is contracted and, in the long-standing cases, fixed in the upper part of the chest. It is surprising how much of the contents of the abdomen can pass into the left side of the chest: the stomach, upper part of the duodenum, most of the colon and practically all of the small intestine and the spleen. The symptoms are vague in many cases, unless there are attacks of obstruction. In approximately one-third of the cases reported operation has been performed for intestinal obstruction and the condition found. Others have been recognized through careful examination which is greatly aided usually by röntgenograms with the barium meal or with barium injected into the colon. The symptoms, then, over several months or several years may be: retracted abdomen, bulging chest, pain, vomiting, tympany of the lower part of the thorax and occasional dulness with displacement of the heart to the right. Often the clinical data are practically negative. Small openings have led to partial hernia of the intestine with incomplete obstruction and perforation into the chest with empyema.

In a case now under my observation (that of an adult with a small hernia in the diaphragm) a knuckle of the side of an intestine came through and strangulated; adhesions formed and perforation with incomplete obstruction occurred. The resulting empyema cavity was drained, and later a larger incision revealed the condition. An attempt at closure on the thoracic side failed and the cavity is still draining. This is a serious condition and the operation will be serious as it will mean local sepsis at least and drainage of the abdominal cavity and closure of an inflamed septic hernial opening into the empyema cavity.

Patients with diaphragmatic hernia are afflicted with all degrees of the complaint from slight to the extreme type with total disability and much suffering. Their condition may aid in determining the justifiable risk the surgeon should assume in operative treatment if the hernia has been diag-

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nosed previously or has been found during abdominal operation or exploration.

TECHNIC OF OPERATION

If the condition has been diagnosed, it will probably be best to perform the operation by opening the upper part of the abdomen with an oblique incision along the left costal margin. In special instances it may be advisable first to open the thorax, but for all practical purposes the abdominal route gives the best control and, theoretically, more should be accomplished from the abdominal side. In a few instances the operative procedures are carried out from above; in a greater number they have been carried out from below, and in certain others both regions are exposed. It is surprising what an amount of force is exerted by respiratory effort to suck the abdominal contents through the hernial opening. The removal of a part of the contents of a large hernial sack by drawing it back into the abdomen can be accomplished without difficulty, but very soon the suction power of a vacuum is made apparent by the difficulty experienced in withdrawing the remainder; the sac appears to be fixed by adhesion. Certain operators have been led to open the chest, the entrance of air permitting the withdrawal of the hernial mass into the abdomen.

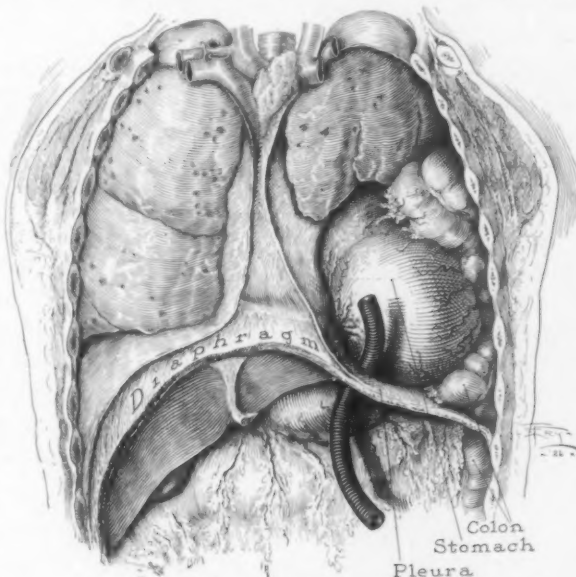


FIG. 1.—Hernia of the diaphragm; rubber tube passed into pleural cavity to relieve vacuum.

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In operating through the abdomen I found that a moderately stiff rubber tube passed into the chest along with the hernia before retraction is made to permit air to enter, minimizes this tremendous suction and the stomach and bowels may be withdrawn without difficulty. (Illustration.) In fact on the value of this device I based my choice of a subject for discussion at this meeting. I believe we should have no hesitation in dividing attached parts of the omentum that are firmly adherent within the chest. The abdominal contents must be well packed off and controlled or they will endeavor again to enter the opening during operative procedures. The opening can be closed in one suture line with chromic catgut and a double or running buttonhole stitch. Balfour found (in a case of railroad injury in 1911 in which he operated in 1915) that half of the opening could be closed, then the remain-

ing half closed at right angles to it, like a capital T. It is not advisable to use abdominal tissue, the wall of the stomach for example, for protection by suturing it to each side of the opening since the stomach will gradually dilate the opening and more and more of the hernial sac will pass into the chest. Quite large openings may be closed by enucleation or division of the lower ribs to permit drawing in of the peripheral attachment of the muscular diaphragm. In operations of expediency the results have been good; if there is strangulation the success of the operation depends, as in all cases of strangulation in the alimentary tract, on the length of time and degree of destruction of tissue.

If the abdominal route is chosen the diaphragm will be found high, but if the opening were made through the chest in the same case, the diaphragm will be found low in the abdomen.

In a case in which Harrington operated closure was made remarkably easy by traction and destruction of the phrenic nerves entering the diaphragm. Contrary to what might be expected, the division of these nerves caused no trouble and the diaphragm was completely relaxed.

The mortality depends on many factors: the age of the patient, the type, situation and size of the opening, the degree of obstruction, and whether or not gangrene and perforation have already occurred. In the twenty-seven cases there were five deaths from operation; two of them a considerable time after operation, one nearly three weeks afterward from pulmonary embolism, and one nearly four weeks afterward, from peritonitis.

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OUR knowledge of much of the pathology following cranial trauma is still very inexact. Many apparently severe injuries to the head will be recovered from completely, while a minor trauma, often ignored at the moment, may later be the cause of symptoms of amazing severity. It is to emphasize this fact and to stress the possible importance of even a trivial cranial trauma in unravelling obscure intracranial conditions that the following cases are reported.

CASE I.—L. B., aged fifty-two, a business man, was referred by Doctor Bastian, of Wilmington, Delaware. Four weeks previously he had fallen down a flight of stairs at night and fractured his collarbone. He was momentarily dazed, but never completely unconscious. There were no external lacerations about the scalp. The degree of head injury was so slight that it was soon forgotten, the broken clavicle being considered the important injury. He spent the next ten days about the house recovering from the general stiffness consequent to his fall. He then returned to his office and for a week carried on his business apparently in normal health. At this time he noticed a dull headache coming on particularly in the late afternoon at the close of the day's work. His business associates noticed a definite falling off in his mental acuteness, he became uncertain in the use of figures and exhibited irritability and lack of judgment. The headaches increased in severity during the next two weeks—he was often at a loss for the proper word, his speech became thick, and finally he had to abandon any attempt at working and take to his bed. We saw him at this time, six weeks after his injury, in conjunction with Dr. William G. Spiller, of Philadelphia.

Physical examination revealed a much disoriented, markedly word-deaf, and aphasic patient. He was semi-stuporous, but could easily be aroused when addressed. Retinoscopic examination showed a definite blurring of the margins of the optic discs of both eyes with tortuous and overfilled veins, but no measurable choking. The feeding test suggested a right lateral homonymous hemianopsia. The pupillary reactions were normal. There was a definite weakness of the right side of the face, especially about the angle of the mouth. The right extremities were somewhat weaker than the left, although he was right-handed. No sensory loss could be found. Slight but equal reduction of all reflexes was apparent. No Babinski, Clonus or Oppenheim were to be noted. The temperature was definitely subnormal but the pulse and respirations were not retarded. Albuminuria was reported. The blood-pressure was 130/80. X-ray of the skull demonstrated a long horizontal linear fracture in the left temporo-parieto-occipital region. A diagnosis of a left-sided ingravescant hemorrhage was made. Immediate operation was advised.

For various reasons operation was postponed for a week, fortunately without marked change in the patient's condition.

A large left temporo-parietal bone flap was turned down by Doctor Grant under general anæsthesia. The dura was tense, non-pulsating and a deep blue-green in color. On opening the dura a bloody serous fluid containing many small clots escaped with a sudden gush. A few small thin clots which could be easily removed remained adherent

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to the dura. In no area were the clots adherent to the arachnoid. The left cerebral hemisphere was compressed to such an extent that the olfactory nerve could be seen anteriorly, the lateral sinus posteriorly. The convolutions were flattened, the blood-vessels thin and compressed while the surface of the brain was of a yellowish-greenish tint. Careful examination failed to reveal any definite source for the hemorrhage. The dura did not appear to be thickened in any area, although its inner surface to which the more adherent of the remnants of the clot still clung was slightly roughened. As we wished to preserve the dura for a perfect closure, no part of it was excised. The bone flap was replaced without decompression. During closure of the wound it

was noticed that the brain was already expanding and assuming a more normal appearance.

Convalescence was uneventful. The wound healed per primam. Within a week the patient was practically normal mentally, although his mind was a blank for events prior to a week before his admission to the hospital. Within three months he was again at his desk and has remained entirely well for over two years.

CASE II.—A married woman, C. McC., aged sixty-seven, was referred by Dr. William G. Spiller. Seven weeks ago while washing windows she fell four or five feet from a ladder to the pavement, striking her head in the left occipital region. A slight laceration resulted. As no one saw the accident, it is not



FIG. 1.—Case III. Low power of entire thickness through dura and underlying clot. The line of demarcation between clot and dura is easily seen. The area of subdural organization and irregular channels throughout the body of the clot are distinctly visible. A, dura; B, clot. H + E stain $\times 10$.

known whether she was ever totally unconscious, but she was able to pull herself together and walk into the house. She did not seem to be much injured and attended to her household duties the next day. From that time on she complained of severe occipital headache and dizziness, but she went about the streets alone and her condition was not considered serious. Ten days ago, one of her sons noticed that the right side of her face drooped. About this time she first noticed that she was deaf. Three days ago she vomited after eating, although this was attributed to her heavy meal. A day later, she was slightly stuporous, her speech was thick and monosyllabic. The next day she was profoundly stuporous, although she could be aroused to answer "yes" and "no".

Doctor Spiller saw her at this time. She was profoundly stuporous, could not be made to say a single word, and kept her eyes tight shut as though photophobic. She had a definite weakness of the right face and right upper and lower extremities. Sensation seemed normal throughout. The tendon reflexes in the upper limbs were normal. In the legs the patellar reflex was reduced on the right and hyperactive on the left; the Achilles normal and equal. There was a positive Babinski on the left. The blood-pressure was 120/70, the blood urea nitrogen normal, while the urine gave a trace of albumen. The eye and eyegrounds were normal. X-ray films of the head were negative. A lumbar puncture showed a clear fluid under 6 mm. Hg. pressure; Queckenstedt test showed a normal rise. Pulse and respirations were not retarded.

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In view of the history of cranial trauma, Doctor Spiller made a diagnosis of intracranial hemorrhage. But because of her age and lack of evidence of intracranial pressure, we thought that she had a slowly developing apoplexy and advised further observation. The evening of her admission to the hospital, her pulse fell to 60 and we agreed with Doctor Spiller that an immediate operation was indicated.

Under light ether anaesthesia, reinforced by novocain, a left temporo-parieto-occipital flap was turned down by Doctor Grant. The dura was tense, non-pulsating and brownish-blue in color. On reflecting the dura a clot about 8 cm. in diameter and 2 cm. thick was exposed. It was slightly adherent to the dura by fine fibrous trabeculations, well circumscribed by a thin membrane, and not adherent to the arachnoid. It could be lifted in its entirety from the cortex. The centre of the clot contained cystic, bloody, grumous material. The cortex was flattened, anæmic and yellow in color. No evidence as to the source of the hemorrhage could be obtained.

The dura did not appear thickened, although its under surface was somewhat roughened and granular. None of it was removed for microscopic study. After complete hæmostasis the dura was closed, the bone flap replaced, and the scalp sutured as usual in layers. As the patient's blood-pressure was low, a blood transfusion was given. The wound healed by first intention. Except for a rather sharp attack of bronchitis, convalescence was uneventful. The patient was discharged three weeks later entirely restored to her normal mental and physical condition. She has remained well for three years.

CASE III.—F. B. F., a lawyer, forty-three years of age, was referred by Dr. Karl J. Kurz, of Mount Airy, Philadelphia, Pennsylvania. While bathing in the surf three weeks before admission he was knocked down and roughly handled by a number of heavy seas. On leaving the water he noticed a buzzing in both ears and was slightly dizzy. About an hour later, while dressing, a severe bitemporal headache developed. During the next hour, his vision became blurred and finally he developed complete blindness in his left eye with marked visual loss in the right. He consulted a local physician who put him to bed and purged him vigorously. The next morning he had recovered his sight completely, and the headache had somewhat abated. He stayed in bed that day, but twenty-four hours later he felt well enough to return home by train. A week after the onset of his trouble, he was back at work, although his head felt heavy and he was less alert mentally than usual.

Four days before admission he left home on an important business trip involving much mental strain. Forty-eight hours later, while examining a witness, he suddenly was at a loss for the proper word and within six hours became completely aphasic, answering only "yes" or "no". He was brought home at once, arriving in a semi-stuporous condition. Convulsions beginning in the right side of his face and involving his right arm next developed. Later he became deeply stuporous and untidy.

On admission physical examination revealed him in deep stupor with frequent convulsive twitchings of the entire right face and right arm, with occasional involvement of the left side of the forehead. The breathing was noisy and stertorous, the face somewhat livid. The pupils were normal in size, shape and reactions. The disc margins were blurred, the vessels overfull and tortuous, but there was no measurable choking. The lower jaw and tongue tended to deviate to the right and the right seventh showed definite weakness. All the extremities were spastic, especially the right arm and hand. The reflexes were all exaggerated especially in the right arm. There was a bilateral Babinski. No sensory loss could be demonstrated. All extremities were moved to pin prick equally well. Pulse and respirations slightly retarded. Temperature normal.

An abscess or a hemorrhage into a left temporo-parietal brain tumor was diagnosed. The trauma involved seemed of minor importance. At best, his condition seemed desperate.

At operation, since an abscess was suspected, a trephine opening under novocain

was made in the left temporo-parietal region by Doctor Grant. On inspection the dura seemed deeply bluish-green. The presence of a hemorrhage was then for the first time realized and with infiltration anæsthesia a left temporo-parietal bone flap was turned back. The dura was characteristic; tense, pulseless and greenish-blue. On incision a bloody grumous fluid escaped. At this point the patient had a violent right-sided convulsion and his respirations ceased. Under artificial respiration they commenced again and the dura was widely opened. This membrane was much thickened, especially over the underlying clot. This clot covered the entire hemisphere from the frontal to the occipital poles and extended over into the median fissure and beneath the brain in



FIG. 2.—Case III. Low power of area of organization lying below dura. The line of demarcation and development of fibrous trabeculae and blood-vessels beneath dura are easily seen. A, dura; B, clot. H + E stain $\times 80$.

the frontal, middle and posterior fossae. It was rather firmly adherent to the dura from which it could be peeled, and, as it came away, fine fibrous trabeculations attaching it to the dura were noted. It was not at all attached to the arachnoid.

In its thickest part directly over the temporo-parietal region, the clot was four centimetres thick tapering off to one-half a centimetre in the frontal and occipital regions. All the accessible clot was removed by suction, but parts of it could not be reached at the base and in the median fissure.

The brain was so compressed that a large clotted mass was easily removed with gentle retraction of the frontal lobe from about the left optic nerve and chiasm. The cortex was flattened, anæmic, and pale yellow in color. A section of the thickened dura was removed for examination. Sufficient clot was withdrawn piecemeal to fill a six-ounce glass, besides that which disappeared into the suction tube. No definite bleeding point could be discovered, but the inner surface of the thickened dura was definitely roughened and oozed freely. The brain was rapidly regaining its normal contour, when, after a careful hæmostasis, the dura was closed. The bone flap was replaced and the galea and skin closed as usual in layers without drainage.

While the wound healed by first intention, convalescence was very stormy. He was extremely restless, disoriented and untidy for ten days. His speech returned slowly. A pleurisy and a cystitis complicated the recovery. However, five weeks after his operation he was sent home and there under familiar surroundings he rapidly regained his normal poise. He was forbidden to return to work for at least three months, but at the end of that period returned to his office. In spite of warnings he overtaxed his strength, and, following an alcoholic indiscretion, he had a right-sided Jacksonian attack in his face and arm with complete aphasia. He recovered in four hours, but was again hospitalized. As lumbar puncture and eye-ground examination revealed no pressure, he was discharged after a week. He then took a sea-voyage and rested for two months. During this time, following a fit of anger, he had one period of transient aphasia lasting an hour. He is to rest six months more at least before returning to work. He feels well, has gained weight, seems cheerful and is apparently his normal self, but he becomes excited rather easily. What the future will bring forth is uncertain, but it seems that the pressure to which his left cerebral hemisphere was subjected has rendered this region more irritable. Either that or the process in his dura is continuing and

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pressing upon the left motor region. Possibly the entire thickened area of the dura, which would have included most of that membrane covering his left lateral hemisphere should have been removed at operation.

The exact pathology of chronic subdural hæmatoma is still obscure. Virchow,¹ in 1857, gave the first comprehensive description of the histology of the membrane. His explanation of its position, etiology, and formation has been freely accepted ever since.

He stated that the hemorrhage lies beneath the dura, outside the arachnoid, and not under the "parietal" arachnoid, a membrane which he showed did not exist. That a subdural hemorrhage might occur from trauma to cerebral vessels, or sudden rupture of a cortical vessel through the pia, or might even occur spontaneously in hemorrhagic, valvular or vascular disease was freely admitted. But from the histological formation of the structure he described and the clinical evidence of intermission and remission of symptoms, he did not believe that a single massive hemorrhage had taken place.

Virchow outlined the development of the condition as follows:

The dura becomes chronically inflamed as is evidenced by the exudation of a delicate layer of fibrin, at times blood-stained, over its inner surface. The widely scattered dural vessels send capillaries into this layer, proliferation of these capillaries follows, and, if the cause for inflammation is again active, another fibrinous layer may form and undergo organization.

As this process repeats itself a very vascular layer of new tissue is built up beneath the dura. These capillaries are extremely thin-walled and irregular, tending to rupture easily if congestion occurs. The subsequent hemorrhage may produce small ecchymotic areas which eventually absorb with the deposition of blood pigment; or a massive hemorrhage may occur from the involvement and rupture of many capillaries. The clot thus formed may in turn be similarly organized with further possibilities of hemorrhage as the vascularity increases. Virchow distinguished between the fibrinous exudation and its organization, which he termed *pachymeningitis interna chronica*, and the condition in which extravasation of blood was the most prominent feature—or *pachymeningitis hemorrhagica*. The blood-filled cysts he termed hæmatomas of the dura. The replacement of the hemorrhagic contents of these cysts by serum (*hygroma* of the dura) he recognized as a type of external hydrocephalus. Large extravasations he considered were always fatal, while small ones might regress.

However, Virchow was describing a condition he had seen in chronically diseased patients, particularly the insane, and not a consequence of traumatic hemorrhage. But there is no reason to believe that if a slow subdural extravasation of blood forming beneath the dura in a chronic wasting disease can be thus organized, that the hemorrhage following a slight trauma cannot undergo the same process and retain the same potentialities for secondary hemorrhage as vascularization of the clot occurs.

Hæmatoma of the dura resulting from trauma has received but scant attention in the literature. Putnam and Cushing² have prepared the most

important recent communication. They show excellently well by microphotographs the variations in structure between the subdural clot subsequent to trauma and that due to a chronic condition. The principal difference in these two types of clot is in their subdural structure. Against the arachnoid the enveloping surface is thin and covered with a layer of mesothelial cells in both instances. But in that area next the dura the clot formed following trauma "is more dense and composed of organizing granulation tissue containing large mesothelium-lined spaces containing blood and fibrin which appear to anastomose with each other and with the capillaries. In this

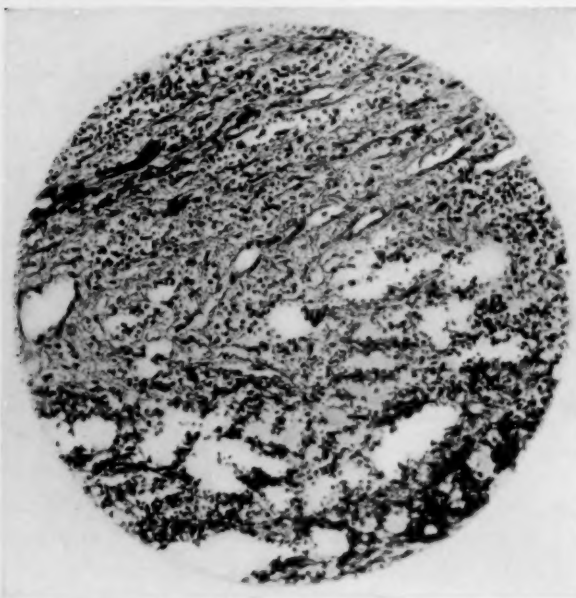


FIG. 3.—Case III. Section between well organized subdural area and less well organized clot. Nature of blood spaces in clot and their irregular size and shape may be noted. H + E stain $\times 300$.

respect the membrane of the traumatic hæmatoma seemingly differs from that of the commonly described pachymeningitis hemorrhagica interna, in which the thin-walled vessels are enormous and no mesothelium-lined spaces are seen. Such a pachymeningitic membrane may possibly give rise to hæmatomas, which symptomatically and in the gross resemble the post-traumatic variety."

But whatever the underlying pathology may be, whether the condition results from a chronic inflammation of the dura in the course of a wasting disease or as a result of trauma, the clinical picture is exactly similar and the treatment is surgical intervention and evacuation of the clot. It is interesting to speculate as to the possibilities of an underlying weakness in the blood-vessel walls in these cases. The trauma which apparently initiates the condition may be so insignificant that it seems almost inconceivable that it could cause the rupture of a normal vessel. Chronic alcoholism seems to be a favoring factor in the production of this condition as pointed out by Kremiansky,³ although Kasemeyer⁴ and Bowen⁵ attach little importance to it.

But even in the traumatic cases there must be very different types of reaction on the part of the dura to the underlying clot. In Cases I and II here reported, the dura did not appear grossly thickened, only slightly roughened here and there with small fragments of clot attached to it. All the rest of the hemorrhagic material gushed out suddenly and escaped as soon as the

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dura was opened. In Case III alone was the dura greatly thickened. From a study of the accompanying plates it can be seen that the structure closely resembles that described as typical of traumatic hæmatoma. The clot is sharply marked off from the dura, well organized, and containing many fine blood-vessels in its subdural surface. The line of demarcation between dura and clot may be easily seen. Within the depths of the clot itself the vessels are extremely irregular in size and shape, are lined with mesothelial cells and contain red cells. Unfortunately a section cut from the material taken from the arachnoid surface of the clot has been mislaid so that the detail of this area cannot be shown.

The symptomatology of an ingravescant hemorrhage beneath the dura may be variable in the extreme. The long latent period is characteristic with usually a slow development of evidence of intracranial irritation and a rather abrupt onset of severe focal symptoms. Distinct remissions in the clinical course are frequent, as though a physiological reduction in the size of the brain occurred to compensate for the increasing size of the clot. Slowly signs of general intracranial tension appear, headache, vomiting and choked disc, while definite localizing signs come on at the last with startling abruptness and usher in a critical situation which may require immediate relief.

But when the very large size of the clot exposed is considered, it is remarkable how very few symptoms are present. Since curiously enough in all three of the patients here reported the lesion was over the left cerebral hemisphere, sensori-motor aphasia was an early finding. A certain mental blunting, irritation, and vague dispositional changes were recalled by near relatives on closer questioning as having been present for some time. After recovering, the patients themselves admitted that they had done things for which at the time they had no logical explanation, acting on a sudden impulse contrary to their customary habits.

The differential diagnosis usually lies between tumor, abscess, hemorrhage, or vascular disease, the degree of consideration given to hemorrhage depending upon the unearthing of a history of trauma. In these three cases the head-injury could be so clearly related to the onset of symptoms that the diagnosis should have been simple. Yet in Case II since no evidence of intracranial pressure existed, either from lumbar puncture or eye-ground examination, operation was at first delayed for an apoplexy was diagnosed. But the sudden drop in pulse showed that we were dealing with a condition requiring immediate relief. In Case III the degree of trauma was so slight that we suspected the presence of tumor or abscess and only when at operation the greenish-blue discoloration of the dura was seen was it realized exactly with what we were dealing.

Many confusing symptoms complicating the clinical picture have been described by various authors. As these three patients were all stuporous or semi-stuporous when first seen, our examinations were not as reliable or extensive as they might have been. The involvement of both sides of the face during the convulsions in Case III was the only confusing sign encoun-

tered. Albuminuria and an occasional rise in temperature were seen in Cases I and II. A slow pulse was not a constant finding. Only in Case I did the Röntgen-ray film show evidence of fracture. Retinoscopic examination showed evidence of pressure in two of these three patients.

The treatment of this condition consists in removal of the blood clot. This is best done by decompression or reflection of an osteoplastic flap. Occasionally, as in one of the cases reported by Putnam and Cushing, a simple trephine over the location of the lesion with the introduction of



FIG. 4.—Case III. Showing position of operative flap.

a brain cannula may result in the evacuation of fluid content of the clot with apparently permanent relief of symptoms. Lumbar puncture has been reported as effecting a successful reduction of pressure in suspected instances of hemorrhage, although in these cases the actual presence of a clot was not confirmed. Certainly lumbar puncture is not to be preferred to direct drainage of the bloody fluid by insertion of a cannula through a trephine directly over it or to complete exposure and removal of the clot by a properly placed osteoplastic flap. Although we

did not resort to it in the cases here reported, the making of a decompression at the base of the flap would seem to be a wise precaution to take care of the œdema of the brain and consequent rise in intracranial tension which may follow the sudden relief of pressure due to removal of the hemorrhage. It is this subsequent acute œdema of the brain which apparently was the cause of death in many of the fatal cases reported in the literature. This may in part be prevented by inserting drainage for a day or two. But if pressure signs develop it seems useless from the experience of other observers to re-elevate the bone-flap or to attempt to relieve the tension by lumbar puncture. Putnam suggests the use of hypertonic solutions by mouth and vein on purely theoretical grounds because other methods were unsuc-

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cessful. However, since the hemorrhage is frequently bilateral and since the undiscovered clot may be the cause of the continued pressure, he wisely advises that a small trephine opening be made routinely over the opposite cortex for inspection of the dura and the determination of the presence or absence of underlying blood. This should certainly be done if the patients do not rally well after the removal of the clot from one side. The first seventy-two hours post-operatively seems to be the critical period. If no complications appear during this time, the convalescence is usually uneventful. The end-results are on the whole very satisfactory, as most of the patients who survive the operation have had few of the usual sequelæ of cranial trauma.

CONCLUSIONS

1. Ingravescient subdural hemorrhage may follow an apparently extremely insignificant cranial trauma. The underlying pathology and predisposing causes of the condition are not clearly understood, although it seems possible to differentiate microscopically between the subdural clot following trauma and that consequent upon chronic systemic disease.

2. Symptomatically the onset of intracranial pressure is insidious with a rather abrupt development of localizing signs pointing to involvement of a definite cortical area.

3. Exposure of the envolved area by surgical means and evacuation of the clot is the proper treatment. Since such hemorrhage is frequently bilateral, inspection of the contra-lateral dura is always indicated.

4. If the post-operative course gives evidence of a return of intracranial pressure, this is due either to general cerebral œdema or an undiscovered contra-lateral clot. Lumbar puncture or re-elevation of the original flap does not seem to benefit the situation. Hypertonic solutions should be given a thorough trial.

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ROOT SECTION UNDER LOCAL ANÆSTHESIA FOR THE RADICAL
CURE OF TRIGEMINAL NEURALGIA MAJOR
(TIC DOULOUREUX)*

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TO BEGIN with, I am quite willing to grant that there are individuals who cannot be successfully operated on *at all*, even for most trivial or minor conditions under local anæsthesia; and furthermore, it is my very firm opinion

that there are some surgeons who will *never* excell in the performance of operations under local anæsthesia, nor even in its administration were it only for the most insignificant procedure.

There is, however, a large and increasing number of men, particularly young men, who have seen perfect local anæsthesia as it can be produced. It is not, however, particularly to these that I wish to address my remarks. It is rather to those who are still in doubt of its advantages that my experience with the method may be of some benefit.

Anyone who has successfully performed any operation under local anæsthesia with novocain, *i.e.*, who has carried it through from beginning to end and performed his operation with satisfaction to himself and without inflicting any pain or suffering on his patient, and has also performed the same operation under general anæsthesia, must have noticed several points of difference in the general and local operative and post-operative phenomena.

Among these, in operations on the brain and its membranes perhaps one of the most striking is the effect on the blood-pressure, or, if you will, let us call it shock. Now the advocate for general anæsthesia will quickly retort that "if the general anæsthetic is administered as it should be, it does not increase the shock." My reply to that is that it has been very conclusively proved that such a statement is not based on experimental research on the lower animals or on clinical observation, for it is well known that the

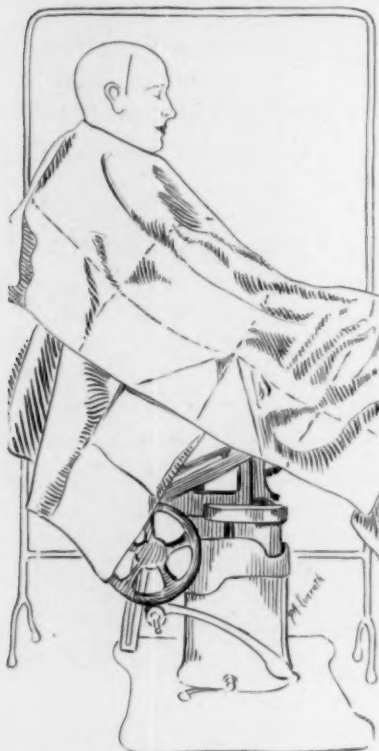


FIG. 1.—The patient is sitting up and will remain so, unless the blood pressure falls and the patient feels weak.

* Read before the Southern Surgical Association, December, 1926.

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prolonged administration alone of ether, gas oxygen, or ethylene, does cause a fall in blood-pressure, and it has not been shown that the administration of novocain subcutaneously in such doses as required has produced any such result.

Another remarkable advantage that the novocain-adrenalin infiltration method possesses over general anæsthesia is the effect on hemorrhage. Every one knows how vascular the scalp is, and those who doubt the seriousness of blood loss from the scalp wound would do well to reflect that Cushing thought so seriously of it that he devised a tourniquet to aid him in its control. Others have spent time and ingenuity in constructing clamps, etc., for the same purpose. Many such devices are on the market. There can be no question of its seriousness. Crile has very clearly shown how blood loss increases shock, and any safeguard for prevention of blood loss is an added protection to the patient.

Three drops of adrenalin solution (1-1000), added to each ounce of the novocain solution, blanches the tissues to



FIG. 2.—A photograph of the patient draped ready for the operation.

such an extent that only the larger vessels bleed when cut or torn. The lack of oozing permits these to be quickly caught and tied. The novocain-adrenalin applied to the dura (as I apply it) does away entirely with the bleeding which accompanies the separation of the dura from the bone and allows a clear field, without the interminable sponging and the unavoidable and oft-repeated trauma and, above all, without accompanying blood loss.

Again the use of a local anæsthetic permits the operation to be performed with the patient in a sitting position. This in itself lessens the congestion in the scalp, skull, dura, and brain. We have been much influenced by this. It can be demonstrated by placing the patient in the horizontal or the half-sitting posture while the wound is still open but such an apparent truth should require no demonstrative proof.

The sitting position for this operation has its advantages other than the prevention of blood loss. The operator and his assistants operate without

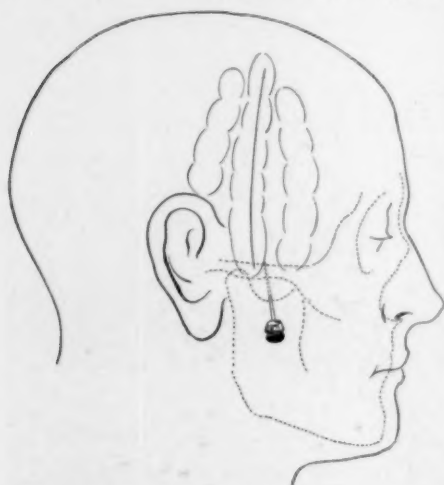


FIG. 3.—The tissues to the bone are infiltrated along the line of incision with 1 per cent. novocain in normal saline, freshly made, to which three drops of 1-1000 adrenalin have been added to each ounce. Now one inch away and on either side from the zygoma upward for a little over one inch, all the tissues are infiltrated with $\frac{1}{2}$ per cent. novocain-adrenalin solution. With a needle four inches long I find the point of exit of the third division just as for alcohol injection and here I deposit 5 c.c. of the stronger solution.

his suffering, disappointment and pain, or he undergoes another operation, which is not so good for surgery.

Again, it has happened that a part of the nerve has been overlooked at operation under general anaesthesia. This is not nearly so likely to happen under local anaesthesia for once the cave of Meckel is opened pain can be excited by touching the crescentic edge of the ganglion with a probe as long as any sensory fibres remain uncut. We have never had to re-operate but once. In that case I wished to leave the upper third of the fibres, according to the method of Frazier, but I left more than I intended and the disease returned—and in the upper division as well.

The post-operative sequelæ are not more frequent under local anaesthesia, as far as I can learn, but I shall when the series is larger make certain on that point.

bending over the wound—a safeguard against infection. The level of the wound can be brought exactly into the horizontal plane, and in that our vision is more acute and more accurate than in any other.

It is true that some, not many, operators perform this operation under ether with the patient in the upright (or nearly so) position. This operation, as is true of other operations within the cranium, may be prolonged, and those who have seen many know it can be bloody. I would not care to keep a patient under ether for a long period of time and maintain the upright position. It has happened that the operation had to be discontinued owing to the condition of the patient, and such a patient if he lives through the operation, after either continues to have his neuralgia

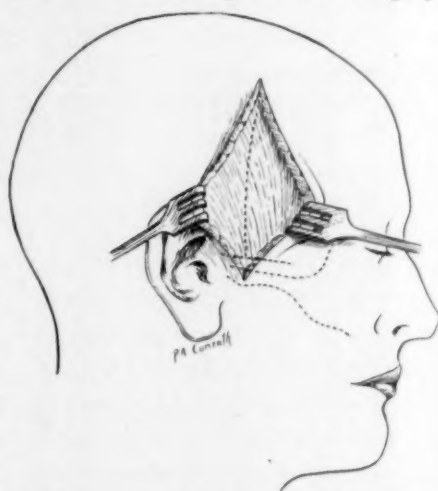


FIG. 4.—The dotted lines like an inverted "T" indicate the incision through the fascia temporalis. The crossed dotted lines show the position of the zygoma.

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Patients who have high blood-pressure sometimes have this disease. I have had several plethoric persons with systolic blood-pressures ranging from 185 to 230. For such it is customary to advise deep injections of alcohol instead of the radical cure by root section. But in all this had already been done twice or oftener, in one four times, one of these had previously been refused operation. They have all been successfully operated upon under local anæsthesia.

Technic.—The head is shaved in all directions for about $2\frac{1}{2}$ to 3 inches away from the site of the proposed incision. The patient is given a cathartic the morning of the day before and light diet given.

The patient's reaction to hyoscine morphine is determined prior to the day of operation, and if not tolerated, producing restlessness rather than drowsiness, no hyoscine is given. If, however, it is well tolerated, $1/200$ grain hyoscine hydrobromide with $1/8$ grain morphine hydrobromide are given subcutaneously one hour before operation.



FIG. 5.—The scalp and temporal fascia are drawn well out of the way by stout silk threads. The lower border of the temporal muscle is then found and the lower fibres freed from their origin and drawn well forward and upward.

Sometimes these patients have acquired a tolerance for morphine, and in these the tolerance is ascertained and such a dose given as will just produce drowsiness. The combination so used has never yet caused me any regrets, but I have had serious consequences in a minor operation with $1/4$ grain morphine and $1/150$ scopolamine. I always try it out first.

The patient sits up either in a dental chair or on a table that can be put in a chair position. Such chair or table can be quickly let down to the horizontal or even Trendelenburg position if necessary. Some patients faint or change their minds with regard to the anæsthetic before (or even after) the operation has begun. I never insist on continuing under local anæsthetic over the protest of the patient.

After the field is prepared, iodine-alcohol method, the towels and sheets

are draped over the head and down over the body and chair to the floor on the side to be operated upon; a slit in the centre of the sheet lies over the line of incision; the sheet is carried up from the field over the head and then away from the patient on the opposite side like a sort of tent-flap. This allows free access of air to the patient and excludes the nurse and the physician (regular anaesthetist) who are always present to watch the condition of the patient and to be available should they be needed.

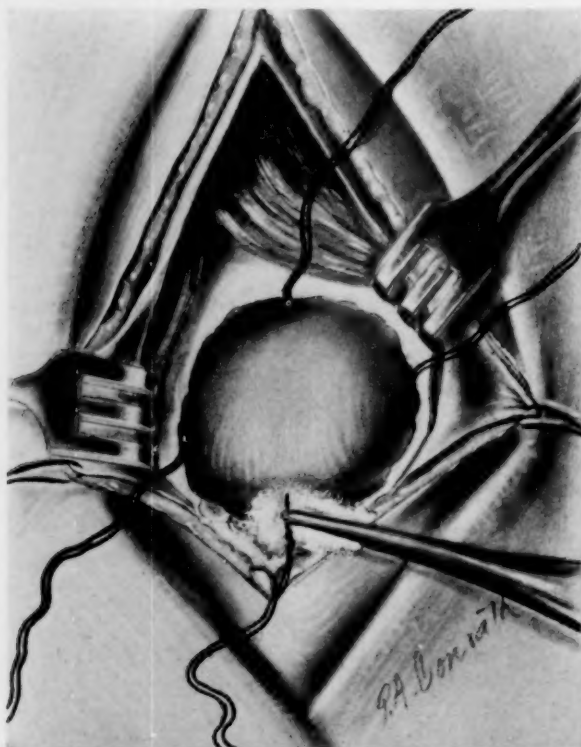


FIG. 6.—The opening in the skull is low down and about the size of a half dollar. Pledgets of cotton to which threads are attached are used for separating the dura from the bone. When the bleeding is severe in one spot, the pledget is left in and the operator works elsewhere for a while. The pledgets are soaked in $\frac{1}{2}$ per cent. novocain, to which the drops of adrenalin have been added to every ounce.

The line of the incision is indicated by scratching the skin. I now use a vertical incision, or sometimes one inclined slightly forward and upward, having found it preferable to that described in my first communication. It reaches from the zygoma upward or upward and a little forward for $2\frac{1}{2}$ to 3 inches, and the lower end is about a finger-breadth in front of the ear.

The tissues to the bone are now infiltrated along the line of the incision. I use 1 per cent. novocain in normal saline, freshly made, and each ounce contains 3 drops of 1-1000 adrenalin. In front of this and one inch away on either side I in-

ject from the zygoma upward for a little over one inch infiltrating as before all the tissues. For this I use only 0.5 novocain-adrenalin. It is well to get as much of the solution as possible under the periosteum over the area of bone to be removed. This is done before making the incision and preferably with the strong solution. It can be easily done if the needle is inserted from above downward in the planes of the surfaces of the temporal and the zygomatic fossæ. With a needle four inches long, I find the point of exit of the third division just as for alcohol injection, and here I deposit 5 c.c. of the stronger solution.

The incision is now made, and any bleeders caught and tied. The fascia temporalis is cut in the line of the skin incision, and in addition it is freed

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from its attachment to the zygoma. This last is done with a scissors, after having carefully lifted up the overlying skin and fat and up-going branches of the seventh cranial nerve to the frontalis muscle. These branches might easily be cut while one is cutting the temporal fascia free from zygoma, for they lie very close to the outer surface. To cut it forward $1\frac{1}{2}$ inches is enough and backward about $\frac{1}{2}$ inch. I have never done the operation without the transverse cut in the fascia. The proper exposure cannot be obtained.

The edges are now retracted and the lower margin of the temporal muscle found. The lower fibres for $1\frac{1}{2}$ inches are cut away from their origin and the periosteum and overlying muscle are loosened and carried forward together. Good retraction is made, so as to expose the lower part of the squama and the wing of the sphenoid above the zygoma. A hole is now drilled and enlarged with a rongeur. The bone is removed well downward quite to the base. The area of the opening need never be more than that of a half dollar (about 3 cm.).

Now begins the task of separation of the dura. This is never done with an "elevator" of any kind.

The dura is often so thin in places that only the inner layer is present and this tears very easily. The suggestion of Tiffany long ago "to separate the dura from the bone with a pledget of cotton grasped in a bullet forceps" I have acted upon. We use cotton pledgets of two sizes, large—about as thick as the thumb and about one inch long, and small about the thickness of the



FIG. 7.—A self-retaining retractor is used for the muscle and overlying structures. A lamp retractor lifts up the dura and brain. The middle meningeal artery has been tied. Most frequently we plug the foramen spinosum with a little wooden peg. The dura covering the third division has been incised, the incision extending backward and upward, and the dura has been reflected from the outer aspect of the ganglion, the sensory root has been cut, the motor root is visible in the background. Running from behind forward and inward and disappearing behind the ganglion can be seen the great superficial petrosal nerve.

little finger and also about one inch long. Each pledget is tied around with a strong black-linen thread, the two ends of which are left long, at least seven inches. These threads hang out through the opening in the skull, as the pledgets are left *in situ* to control oozing, and having the threads long and black prevents the leaving of one within the cranium. The cotton pledgets are wet with the 0.5 per cent. novocain-adrenalin solution and grasped in an ordinary, rather long, dissecting forceps. If the patient complains, the pledget, very wet, is gently placed at that point and allowed to remain and another

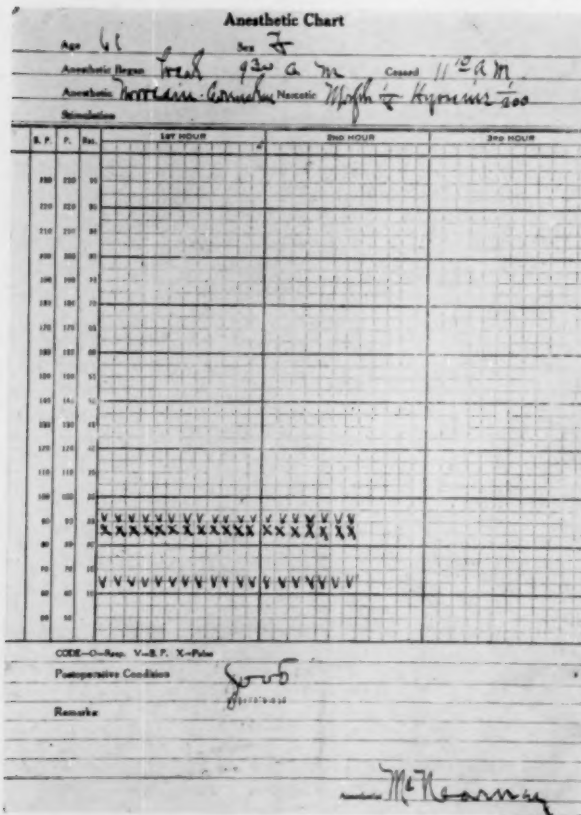


FIG. 8.—Blood pressure chart. This chart is on the back of the ordinary operation sheet.

point is attacked. This is kept up until the dura is entirely separated as far as the foramen spinosum. If a point is reached where there is much oozing or real bleeding one of the larger pledgets packed between dura and bone controls it and the operator turns his attention to some other point for a few minutes. One is surprised at first on removing such tampon to find a dry field, but he soon learns that is a usual happening. Often I have as many as four or five tampons within the cranium at the same time. If in spite of all care the dura is torn, I do my utmost to repair it at once using mattress silk sutures.

When the foramen spinosum is reached the middle meningeal artery is found. At first we often had to stop and use much of the 1 per cent. novocain on pledgets here, and also when we had reached the foramen ovale. Since we began to use the deep injection of novocain outside the skull at the exit of the third division, I have not noticed any protest on the part of the patient while dealing with the artery.

Sometimes one can use a blunt feeler and discover the direction of the canal through which the artery enters the skull. If this is once learned it is very simple to make a little peg (I use a bit of an applicator). These pegs are pointed a little at one end and are never more than about one-third to

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one-fourth of an inch long. One can press such a peg into the hole alongside the artery and leave it there and then cut the vessel. In my early cases I ligated it with silk. I have had to ligate the distal end once.

The dura is firmly fixed to the third division, where it leaves the skull, and is incised before it can be raised from this division and the ganglion. If this is painful, I inject some of the 1 per cent. novocain right into the third division where it leaves the ganglion. After a few minutes the dura can be pushed up and the ganglion exposed. One works backward and inward and a little upward, and presently the inner layer of dura is seen stretching from the outer layer (outer wall of cave of Meckel) onto the ganglion itself. This inner layer is now cut and the cerebrospinal fluid begins to flow. If, before this, one has secured a good separation of dura as far as the apex of the petrous, by hooking the beak of the retractor (author's pattern) into the opening of the cave, he can now have a good exposure of the sensory filaments as they join the posterior crescentic margin of the ganglion.

Even though one may be able to painlessly separate the dura from the ganglion, yet I find that very often just touching the sensory fibres excites pain. To anæsthetize them I take a very small, soft pledget of cotton and, after soaking it well in 10 per cent. novocain, lay it in the cave on the root and remove the retractor. After three minutes the fibres are cut a few at a time, using a long-handled, small, sharp knife.

The sensory fibres undulate in the waves of cerebrospinal fluid as this respond to respiration or heartbeat, that, their size (smaller than the motor root), their attachment to the ganglion, and their different shape (they are round, the motor root is flattened) as well as the fact that the motor root is likely to be a shade whiter in color, all enable one to distinguish them from the motor root.

After cutting the sensory fibres, all cotton pledgets are removed from the wound. If there is any bleeding-point, a bit of muscle is laid on it, and a larger bit is laid in the cave to stop the cerebrospinal fluid from flowing. The wound is closed without drainage and a generous dressing applied.

A goggle with close-fitting rubber rim is applied for a few days, or, if none is at hand, the lids are kept closed with collodion or adhesive or both.

THE IMPORTANCE OF RÖNTGEN EXAMINATIONS IN THE DIAGNOSIS OF FRACTURES OF THE SKULL

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AND

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FROM THE SURGICAL CLINIC OF THE SERAFIMERLASARETT, STOCKHOLM (DR. TROELL)

IT IS quite true, of course, that the serious prognosis associated with fractures of the base of the skull is not so much to be ascribed to the fracture itself as to the lesion of the brain; the disastrous effect is the result of a sudden, marked increase of the intra-cranial pressure, largely caused by the hemorrhage accompanying the fracture. Nevertheless, clinical experience shows that even injuries to the head, not clinically diagnosed as fractures, but only looked upon, for example, as a contusion of the head complicated by cerebral concussion (*commotio cerebri*), may give rise to very prolonged and troublesome sequels. This is particularly the case where the surgeon in attendance, in considering the injury to be of relatively mild nature, permits an early discharge of the patient and allows him soon to resume his usual work. This is emphatically brought out by the social accident insurance—as an illustration it may be mentioned *that out of 152 cases of cerebral concussion, compensated by the Swedish State Insurance during 1918–1920, no less than 9, or nearly 6 per cent., have had to be granted for at least some year rent.* In writing out certificates it is a poor consolation—and in many cases surely quite unfounded—trying to convince the patient and oneself that it has “merely” been a question of a traumatic neurosis in consequence of many a time a brief and, as it seemed at first, rather an unimportant injury. It is our definite impression that many, perhaps most, of these for a long time persistent and symptomatically very varying post-traumatic troubles are due to the fact that the injury from the outset has been anatomically of much more serious nature than the usual clinical examination has given reason to believe. In recent years we have had the opportunity at the Serafimerlasarett—thanks to the great courtesy and help from the röntgenologists (Professor Forssell and his assistants) to verify this supposition by supplementing the clinical findings with Röntgen photographs. For it has been shown by these that even in cases where otherwise evident symptoms have given no reason at all for suspecting fracture of the skull, such lesions nevertheless occur in head injuries much more often than can be established by purely clinical methods. Röntgenology, therefore, has also here, as in fractures on the whole, proved its great importance as an aid to diagnosis.

The following account is a tabularized summary of serious head injuries (except gun-shot and kindred injuries) for the period April 1, 1922, to December 1, 1926, admitted to that part of the surgical department at the

RÖNTGEN DIAGNOSIS OF SKULL FRACTURES

Serafimerlasarett, which, as long as it was divided into two clinics, constituted Clinic I. All head injuries, clinically diagnosed as fractured base, contusion and compression without concussion of the brain, have been included, and in addition those cases of head contusion with or without scalp wounds which, although without definite cerebral symptoms, yet were of such nature as to call for Röntgen examination; finally, for the sake of completeness we have also included cases of *fractura thecæ cranii* from blunt injury (all other fractures concern the base of the skull).

Below will be submitted, for the sake of clearness a tabulated summary of the results obtained after inquiring into the clinical reports in regard to the question *how often Röntgen has been positive and negative in the diagnoses set out below, based upon ordinary clinical examinations.*

	Purely clinical diagnosis	Fracture detected by Röntgen	No or uncertain fracture according to röntgen	Röntgen not done
1. Severe head contusion with or without scalp wound	14 cases	5 cases	9 cases	
2. Cerebral concussion	118 cases	11 cases ¹	45 cases ²	62 cases
3. Cerebral compression	23 cases	17 cases ³	4 cases ⁴	2 cases
4. Cerebral contusion	7 cases	1 case	4 cases	2 cases ⁵
5. Fracture base of skull	7 cases ⁶	6 cases	1 case ⁷	.....
6. Fractura theca cranii	6 cases	6 cases	.....	.....
	.....	46 cases	63 cases	66 cases

Total, 175 cases of which 109 have been röntgenologically examined.

1. Five of these cases were bleeding from ear or nose. 2. Three of these were bleeding from the ear. 3. Eleven of these were bleeding from the ear, etc. 4. Two of these were bleeding from the ear, etc. 5. Both dead and examined post-mortem: fracture present. 6. In all these seven cases there was bleeding from the ear in addition to paralysis of N. VII or, in one case, N. VI. 7. Clinically this case was an undoubted fracture.

In Bloch's * excellent account three factors are given as absolute evidence in favor of fractures of the base: 1. Fall from some height or similarly obtained head injury. 2. Bleeding from the ear (or possibly nose or mouth). 3. Facial paralysis. As other valuable symptoms are given: 4. The finding of brain substance in ear or nose. 5. Cerebrospinal fluid from ear (or nose). 6. Secondary hemorrhage in the cutis of the eyelids or in the subconjunctiva.

Quervain † gives the following symptoms in support of the diagnosis of subcutaneous fracture of the skull: 1. Direct and indirect pain on pressure. 2. Displacement and abnormal mobility. 3. Hemorrhage (of very great diagnostic importance; frequently the only symptom) from ear, mouth, nose, or subcutaneously. 4. Escape of cerebrospinal fluid. 5. Alteration of percussion. 6. Röntgen. "Lassen sich auch die Schädelbrüche meist ohne dasselbe erkennen, und fehlen auch in vielen Fällen von klinisch festgestellter Fraktur Veränderungen im Radiogramme, so bringt uns dasselbe doch in anderen Fällen eine willkommene Bestätigung der Diagnose und zeigt uns sehr genau Form und Verlauf der Bruchlinien" (page 6).

* Chirurgen i Klin. forelaesninger: Bd. Ia, p. 62.

† Chir. Diagnostik: 1919, p. 1. Most authors of text-books say nothing about Röntgen.

In the light of these statements appearing in text-books—and in view of the general impression probably formed, on the whole, by hospital surgeons regarding the frequency of fractures of the skull—our figures from the Serafimerlasarett would seem to deserve due consideration. Röntgen has unfortunately not been employed in as many cases as might have been wished.‡ In the first year (1922) it is lacking in no less than 85 per cent. in cases of cerebral concussion; in the subsequent years in about 50 per cent. The investigations have made it quite clear, however, *that fracture of the base of the skull is of far more frequent occurrence than can be established by purely clinical examination. Out of all cases röntgenologically examined, 109 in all, fracture of the base could clinically, without Röntgen, be considered definitely certain in only 7 cases* (injury to head plus bleeding from ear plus paralysis of N. VII or VI; in only one of these cases was Röntgen negative). In 21 cases of cerebral compression, clinically diagnosed, there were no less than 17 with a fracture visible under the Röntgen-rays (11 of these had in addition to compression symptoms bleeding from the ear, nose or mouth). In 56 cases with a clinical picture of cerebral concussion there were 11 fractures (5 of them had bleeding from the ear, etc.). And of 14 injuries to the head which showed no signs of intracranial complications, there were 5 fractures. In the material under review, therefore, Röntgen has shown itself an exceedingly valuable aid to diagnosis; thanks to this *fracture of the base was detected in no less than 17 of 21 cases* (ratio 1: 1.2), *clinically diagnosed as cerebral compression, and in 11 out of 56* (ratio 1: 5), *clinically diagnosed as cerebral concussion.*

It stands to reason that at least some of the more or less persistent symptoms occurring after severe head injuries are due to some organic injury—fracture—of a kind not definitely demonstrable by ordinary clinical examinations; and so, even should the diseased condition itself have had a relatively short duration. It is therefore of considerable importance, not least in regard to the generous compensation liabilities guaranteed by the state social accident insurance in injuries through accidents during work, to supplement the examination of head injuries by Röntgen, even should the symptoms otherwise indicate no more than a cerebral concussion or compression, and even should in severe trauma symptoms of some of these intracranial complications be missing.

‡ The chief reason for not examining a case under Röntgen has had nothing to do with it being considered particularly mild. It has been more connected with the necessity—from want of accommodation—to discharge the patient as soon as possible for further treatment at home or elsewhere.

EXPERIMENTAL SURGERY OF THE OESOPHAGUS*†

SOME FACTORS AND END RESULTS

BY GEORGE L. CARRINGTON, M.D.

OF DURHAM, N. C.

THE present status of oesophageal surgery is ample evidence of the difficulties that it presents. While the cervical oesophagus is relatively accessible, the thoracic viscus is one of the most inaccessible organs of the body. It lies in the cavity that contains the chief elements of the circulatory and respiratory apparatus and is in close proximity to the great vessels and important nerves. It is short and by reason of its attachment to the pharynx above and to the diaphragm below it is subjected to a pull with each act of deglutition and with each respiration. The resection and suture of a viscus with such attachments is a very different matter from that of a loose lying coil of intestine. Not only does it differ in the matter of tension, but the intestine is covered by a serous coat that is resistant to infection and that quickly throws out a plastic exudate to seal a suture line. Again, the lumen of the normally healthy stomach and small intestine is relatively free from pathogenic bacteria, while the lumen of the oesophagus may contain practically any of the organisms found in the mouth. The ease of the development of a mediastinitis or a pleuritis, and the severity of such infections when they have occurred, would render this field different from others even if surgery here were not handicapped by the immediate operative problem of sustaining life by artificially maintaining respiration during manipulations. In addition to these things, the blood supply of the oesophagus when compared to that of the intestine is poor—and the circulatory factor is always one of the chief elements in healing.

Until Sauerbruch devised his differential pressure apparatus some twenty-two years ago, little clinical or experimental work had been done in the chest, beyond the drainage of fluid or pus from the thoracic cavity. When this method had been simplified by the development of the Meltzer-Auer and other apparatus for positive pressure intratracheal insufflation, thoracic surgery had then had its foundation prepared and its cornerstone laid. Before that time it is true that an occasional surgeon would attack the oesophagus in case of injury, endeavoring to operate without opening the pleural cavity. The Russian, Nasiloff, first worked out an approach through the posterior mediastinum. Since then a number of surgeons have used this method of attack, each more or less modifying it to suit his special needs. Lilienthal's¹

*The work upon which this paper is based was done in the Brady Laboratory of the Yale Medical School and in the Laboratory of Experimental Surgery of The Medical School of the University of Pennsylvania.

†Read before the Philadelphia Academy of Surgery, May 2, 1927.

partial success by this route is probably the best known example. But the extreme difficulty of avoiding a tear in the pleura and the difficulty of "cruising" sufficiently to handle the pathology adequately will no doubt prevent its great development. This last difficulty was probably responsible for Lilienthal's failure to obtain a lasting success.

A number of approaches have been tried for œsophageal work. In the neck an incision along the anterior border of the sterno-cleido-mastoid muscle gives a fairly satisfactory approach from either side. In the chest the long intercostal incision popularized by Torek, with the addition of adjacent rib-cutting near the spine when necessary has been the one most frequently employed. A number of surgeons, however, prefer the posterior mediastinal route as we have said; while a few, of whom Von Mikulicz² was first, have tried an anterior approach, dividing or removing the sternum. Kummel, Rehn, Levy and Lilienthal all seem to favor an extra-pleural operation. In dogs a long intercostal incision has been employed for the most part—usually in the eighth interspace. The incision may be made on either side. I have usually gone in on the right side because it gives a good exposure without the heart's interfering with the operator, and I think, without the operator's interfering with the heart quite so much.

Biondi as early as 1896 had opened the left pleura, incised the diaphragm, pulled a part of the stomach into the thorax, resected a portion of the œsophagus, closed the lower stump and anastomosed the upper segment to the stomach. Dobromyslow,³ working in Tomsk in 1901, performed a successful intra-thoracic suture of the œsophagus. He used two rows of silk sutures. Mikulicz in 1904 resected four centimetres of the lower end of the œsophagus, made an end-to-end anastomosis, mobilized the œsophagus, transposed the suture line to the abdomen through the hiatus in the diaphragm, and sutured the diaphragm to the œsophagus above the anastomosis. The dog lived six weeks. In 1913 Omi,⁴ in South Manchuria, reported seven out of nine successful anastomoses of the cervical œsophagus; and of five intra-thoracic œsophago-gastrostomies three showed intact suture lines, though two of these died. He used silk sutures in three layers—the first through the mucosa, the second through the muscle and adventitia and the third through the muscle. He thought the anastomosis sufficiently reliable for use in man, if dog work is applicable to the human. Laird F. Kroh, Henry P. Brown, and Harry Bailey working in the University of Pennsylvania Laboratory reported in a paper read before the Deaver Society in 1913, but not published, the successful performance of six out of six end-to-end anastomoses of the cervical œsophagus. They had first performed four unsuccessful operations, using two layers of continuous sutures. In the six successful operations that they performed they used three layers of interrupted sutures. The first layer included the mucosa only, the second layer took in muscle and adventitia, and the third consisted of a row of stay sutures to take the tension off the other layers. They also made the observation that the stricture at the site of operation decreased as time went on. The dogs were sacrificed at intervals of 59 to 120 days.

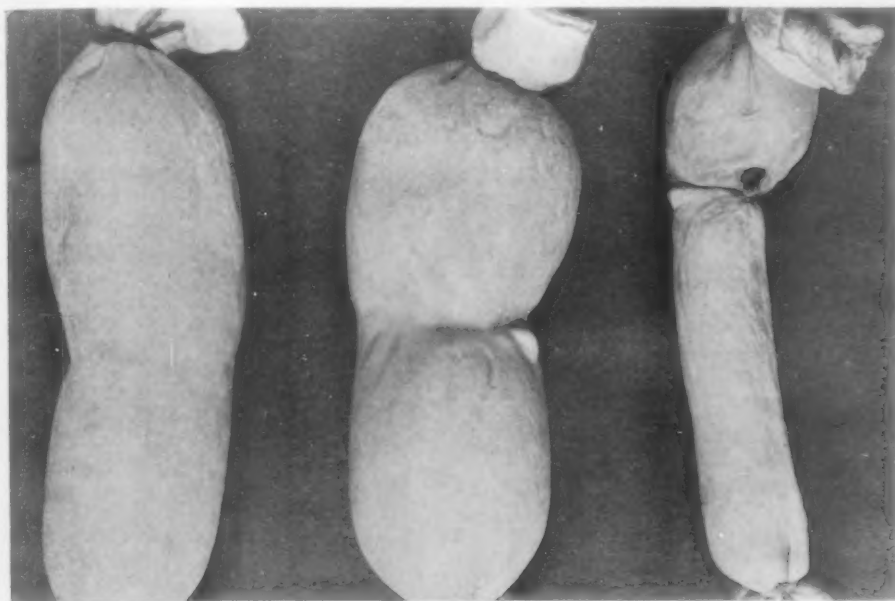
Sauerbruch⁵ after a long and discouraging effort to perform a successful end-to-end anastomosis decided that it was impossible to do so by suture, but he did succeed ten times out of thirteen in anastomosing the œsophagus to the stomach by means of a Murphy button. He laid great stress upon the necessity of preserving the most careful asepsis in the thoracic cavity.

Miller and Andrus⁶ operated upon eighteen dogs, using a modification of Doctor

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Halsted's⁷ bulkhead operation in order to preserve asepsis in the chest. They anastomosed the oesophagus to the stomach. Of these animals, fourteen survived operation, and eleven of the survivors had intact suture lines. Of these eleven, however, two died of dilatation of the stomach after 21 and 24 days, four of distemper 3, 7, 17 and 20 days after operation, and one of diaphragmatic hernia on the sixth day. Three others died of infection. Of the ten dying, however, all had intact anastomoses.

The effort to relieve tension from the suture line and to replace oesophageal defects have taken many forms. It is sufficiently difficult to make a



1 (Thorax 126 days)

2 (Thorax 37 days)

3 (167 days)

FIG. 1.—All specimens except No. 12 show the oesophagus distended with preserving fluid. No. 12 shows the specimen cut open and presenting the mucosal surface at the site of the anastomosis. Some of the silk sutures are visible. It will be noted that in this seven-day specimen epithelization is almost complete. Specimens Nos. 4 and 10 show the exterior of the oesophagus. Specimens Nos. 1, 2, 3, 5, 6, 7, 8, 9 and 11 are all turned inside out and distended with preserving fluid. These specimens thus show the actual size of the lumen at the site of anastomosis as compared with the size of the remainder of the oesophagus. They show the condition of the mucosa and the marginal ulcers with projecting suture material. Specimens Nos. 1, 2 and 9 are from the thoracic portion of the oesophagus. The others are from the cervical portion.

permanently successful anastomosis after simple division of the viscus, but when a considerable portion of the organ is removed—as must be done clinically for carcinoma—then for an anastomosis to be successful some plastic or substitutive procedure must be employed. These have been numerous; and their very number means that perfection is still far off.

Dr. Duff S. Allen⁸ recently tabulated these procedures as follows:

1. Cervical oesophagoplasty by means of skinplasty.
2. Extrathoracic oesophagoplasty by means of skinplasty of neck and anterior thorax.
3. Inferior extrathoracic oesophagoplasty by use of a portion of the jejunum.
4. Inferior extrathoracic oesophagoplasty by use of a portion of the jejunum and skinplasty.

5. Inferior extrathoracic œsophagoplasty by use of a portion of the transverse colon.
6. Inferior intrathoracic œsophagoplasty by use of the stomach.
7. Inferior extrathoracic œsophagoplasty by use of a tube of the anterior wall of the stomach.
8. Inferior extrathoracic œsophagoplasty by use of a tube of the greater curvature of the stomach.
9. Inferior extrathoracic œsophagoplasty by use of the first horizontal portion of the duodenum.
10. Posterior thoracic œsophagoplasty by the use of skin flaps. Reconstruction of half of the circumference of the œsophagus with fascia has been done by Razzaboni and Neuhoof.
1. Cervical œsophagoplasty by use of the sheath of the rectus and peritoneum.
2. Cervical œsophagoplasty by use of the fascia lata.

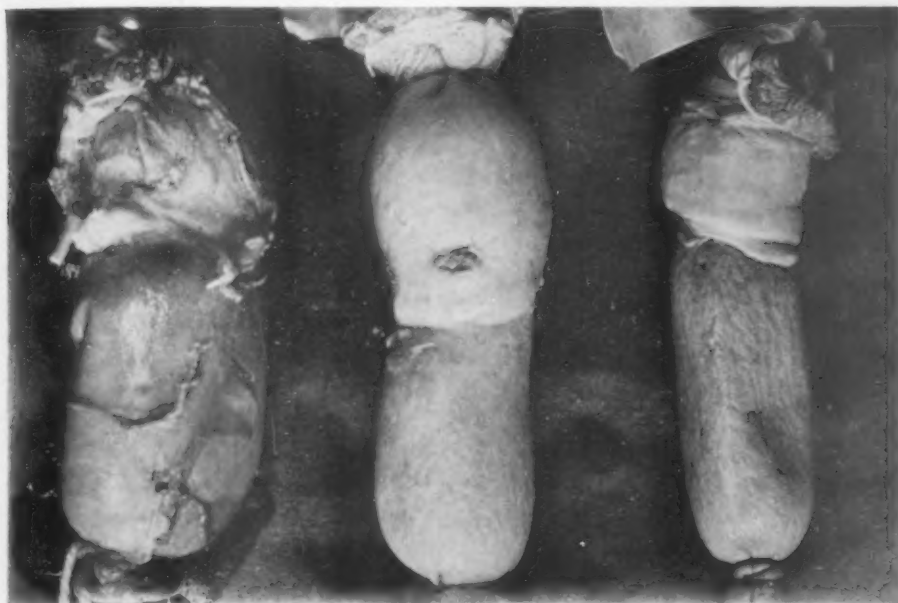
Torek⁹ has been firmly of the opinion that for carcinoma the whole œsophagus should be removed. His successful case had this procedure, as did also the later case reported by Eggers.¹⁰ In both of these a gastrostomy was done, the tumor-bearing portion of the thoracic œsophagus resected, the cardiac stump inverted and the oral stump brought out through the neck on the chest. Many of the methods devised by experimenters in their efforts to remove the œsophagus aseptically have been ingenious. Levy¹¹ did a gastrostomy, passed a tube with a thread down the œsophagus, divided the viscus in the cervical region and then by means of the thread invaginated the lower portion into the stomach. Kelling, 1902, did very much the same kind of thing but pulled the œsophagus out through the neck instead. He made an incision in the chest and freed the œsophagus, did a gastrostomy and resection of the lower œsophagus from the abdominal side, plugged up the lower end of the viscus and then pulled it out through the neck incision. Ash, 1912, did much the same thing, but used only two incisions—one in the neck and one in the abdomen.

The question of drainage has given rise to a variance of opinion. Air-tight drainage has been demanded by some surgeons (Kuttner, Meyer, Tiegel, and Mikulicz) while some, among whom is Sauerbruch, close tight without drainage. Of course, after resecting any dirty viscus with chances for infection rather high, most surgeons want to drain. But the difficulty of maintaining drainage and lung expansion, too, is practically insurmountable in dogs and in humans requires special equipment. Keeping the lungs expanded is of the first importance, for the pleura appears to be much more subjected to infection in the presence of a pneumothorax than when the lungs are fully expanded. In dogs the lungs should be distended to fill the chest cavity before the thoracic wall is closed.

Our initial attempts at suturing the œsophagus were made in the cervical region. An incision was made along the anterior border of the sternocleido-mastoid muscle, the carotid vessels and vagus were pushed medialwards and the œsophagus lifted out of its bed. In one dog a longitudinal incision was made in the viscus. This was closed with two layers of interrupted sutures and healed nicely. Then in another dog a longitudinal and a transverse incision were made. These were closed as in the first dog with two rows of interrupted Lembert sutures, and these healed nicely. The second dog upon which we attempted a complete transverse section of the œsophagus survived for 37 days before he was killed in a dog fight. In

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that dog, the oesophagus after being delivered was clamped with two Kocher clamps, a row of interrupted silk Lembert sutures was placed all the way around the oesophagus, which was then cut between the clamps. The sutures were drawn tight and the clamps carefully released and withdrawn. The sutures were again drawn tight as the clamps were removed, and this time were tied. Another similar layer of interrupted silk Lembert sutures were placed outside the first row. Each suture included muscle and adventitia. The neck wound was closed tight and the dog made an uneventful recovery.



4 (91 days)

5 (406 days)

6 (441 days)

FIG. 2.—See legend under Fig. 1.

It was the only successful case obtained by that technic. The other dogs developed either a fatal mediastinitis or more frequently a sloughing oesophagus that failed to hold.

Later we modified this method of anastomosis and included tension sutures as a result of the work of Doctors Kroh, Brown, and Bailey, which was called to our attention through the kindness and interest of Dr. J. E. Sweet. All the anastomoses reported in this series were performed essentially according to the following technic:

After delivery of the oesophagus the surrounding tissues were packed off by warm moist gauze. The oesophagus was encircled by two narrow tapes placed about two inches apart. These tapes were drawn tight enough to prevent noticeable leakage through the lumen, but not tight enough to damage the muscular coat. In the portion of the oesophagus between these tapes a small incision was next made, or a Luer needle was inserted into the lumen, and either through the incision or the needle a solution of some anti-

septic was injected—mercurochrome 220, a weak iodine or a chlorine solution. After the lapse of what was thought to be sufficient time for the sterilization of the lumen the œsophagus was divided in this supposedly sterile area. Three points on each cut end of the œsophagus were caught up each equidistant from the two other points on the same end, and joined by an interrupted suture to the corresponding points on the opposing cut end. These sutures were tied and temporarily left long, to serve as traction points. The first suture row was then placed by connecting each of the three points by means of a continuous over-and-over suture through all layers of the viscus. On each side of this first row of sutures other points were selected equidistant from one another on the circumference of the œsophagus. These corresponding points were again joined, but this time by interrupted Lembert sutures through the muscle and adventitia only. These three sutures were tied and the ends again temporarily left long for traction points to facilitate the placing of the second row of sutures, which consisted of interrupted Lemberts through the muscle and adventitia. After this row of sutures had been placed and a water-tight suture line obtained, the tapes were removed from around the œsophagus and a row of tension sutures inserted. These consisted of six interrupted Lembert sutures through muscle and adventitia, each suture taking a long bite of tissue. These sutures were drawn only sufficiently tight to relieve the tension on the first two rows. Thus the anastomosis consisted of (1) a row of continuous sutures through all coats of the œsophagus, (2) a row of interrupted Lembert sutures through muscle and adventitia invaginating the first row, and (3) a row of six interrupted Lembert sutures through muscle and adventitia to relieve tension. All suturing was done with the opposing ends fully dilated in order to minimize the production of stricture. In the neck the external wound was closed loosely. In the chest a strong air-tight closure was employed.

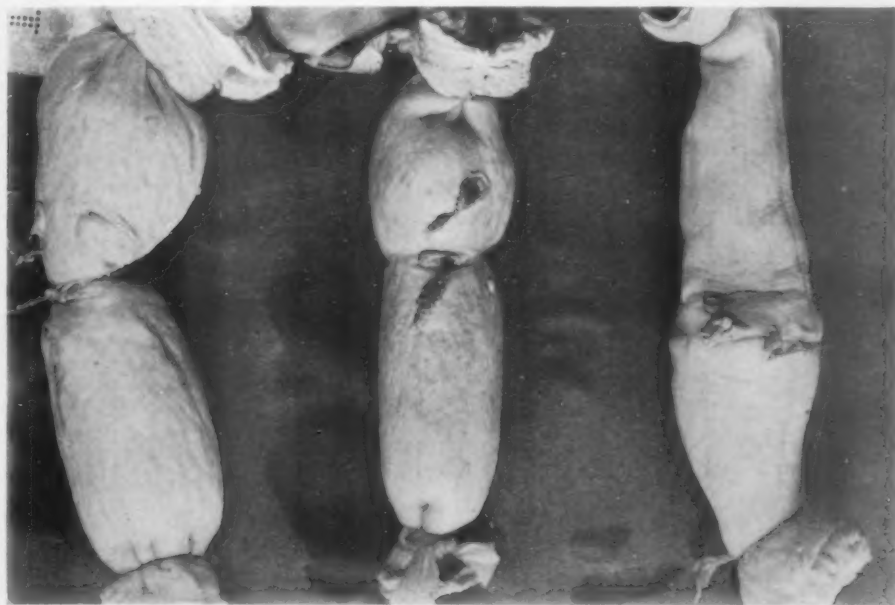
The cervical œsophagus was the site of operation in eighteen dogs by the above technic. Of these nine were successful. They were sacrificed at intervals of from seven to four hundred forty-one days. Only two were sacrificed under three months, as we wished to see the late end results. Of the nine failures, two were poor operative risks, and one had a poor and septic operation as a result of anesthetizing and operating team mishaps. One of the poor risks died the day of the operation. The other failures died at intervals of one to six days after operation. Most of them had a partially or totally divided œsophagus, and an extensive cervical infection, often with an associated purulent mediastinitis.

The thoracic operation was performed upon nine dogs. Of these three were successes and six failures. The three successful dogs were sacrificed at intervals of 54, 76, and 126 days after operation. All six of the failures had an empyema thoracis. These six unsuccessful cases died at intervals of one, two and three days after operation. In some the suture line was intact, while in others the œsophagus was sloughing at the site of anas-

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tomosis. This variation was found in both the cervical and thoracic anastomoses. At times there would be an apparently perfect anastomosis surrounded by a foul collection of pus, while in other animals we have found an œsophagus pulled apart in an area showing far less extensive signs of infection. Whether this variation was due to difference in blood supply of the œsophagus, to difference in invading organisms or to other factors we do not know.

The end results in the successful cases were remarkably good. All twelve dogs at the time of sacrifice were in excellent condition—even the one



7 (119 days)

8 (168 days)

9 (Thorax 76 days.)

FIG. 3.—See legend under Fig. 1.

killed at the end of seven days. The routine feeding after operation was a quart of milk a day and all water desired for ten days. Then for three weeks they were given a diet of soft food without bones or hard crusts. After that time they received "house diet" in the dog pavillion. When they began to receive solid food it required several weeks for them to learn to chew it properly. At first they would swallow the food pretty much whole and when it lodged in their œsophagus they would regurgitate it and then try again. Gradually, however, they learned to chew bread and bones into small pieces before attempting to swallow them. Still later as the anastomosis probably stretched they were usually able to swallow rather large boluses of poorly masticated food. All the dogs handled the problem, though, and those that were kept for six months to fourteen months stayed decidedly fat.

Of the twelve specimens removed only one showed a marked stricture.

This one (No. 7) had a stricture that would just admit the terminal phalanx of the little finger. Yet as I have said above, this dog was able to stay in excellent condition, and 119 days after operation was well nourished. The condition of this dog was interesting in other respects. At the time of operation a note was made that the musculature of the œsophagus was unusually tender and did not hold sutures well. The specimen at sacrifice showed in addition to the stricture five ulcers in the mucosa at the site of anastomosis, and from each of the ulcers projected a piece of the silk suture used. The mucosa furthermore was markedly discolored and had a distinctly greenish tint. If we had known of this beforehand, it would have been interesting to wait a while longer and to have seen what would have been the course of events. None of the eleven other specimens showed any discoloration. Most of them had slight stricture formation, but in some the site of anastomosis was almost indistinguishable from the adjoining tissue. Most of the specimens had one or more marginal ulcers about the site of the anastomosis, though three specimens showed perfect healing. From each ulcer found there projected a piece of the unabsorbed and unabsorbable suture material used. One of those showing perfect healing was sutured with chromic catgut.

DISCUSSION

There are many factors involved in œsophageal surgery. Tension and infection are among the most important. No extensive resection can be done without some plastic substitutive operation. Tension sutures help when an anastomosis is made. Sterilization of that portion of the lumen of the œsophagus that is to be the site of operation is of benefit. Without a tape or some form of pressure on each side of an incision in the œsophagus, saliva from the mouth and gastric contents will be emptied into the wound. In the neck, leaving the external wound open helps to prevent infections that damage the anastomosis and that burrow into the mediastinum. Strictures need not to be feared. The specimens here shown are conclusive evidence that good anatomical and physiological results are obtainable. Our impression is that silk sutures are superior to chromic catgut for this work, even though they result in ulcers. The catgut does not seem to hold long enough constantly, and clinically a piece of silk suture protruding from an ulcer could probably be removed through the œsophagoscope without great difficulty. The blood supply of the œsophagus is poor. That is no doubt partly responsible for what at times appears to be caprice in the obtaining of results. That factor, however, cannot be greatly altered. Infection is in our opinion the problem the solution of which will do most to obtain the "Open Sesame" for obtaining a constant high percentage of good results. We are of the opinion that before thoracic œsophageal surgery is satisfactory a successful chemo- or bio-therapy, probably an immunological one, will have to be worked out. Possibly an air-tight drainage operation with suction to

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keep the lung expanded will be of use until that time. The prevention of a pneumothorax and the closure of the chest with the lungs fully expanded is now most important, for without doubt the pleura is more subject to infection in the presence of a pneumothorax. This belief about the importance of infection in thoracic work is founded not only on this series of experiments, but upon a later series ‡ also, in which mobilization of the stomach into the chest was done with great care about asepsis. In a large number of these animals (dogs) no hollow viscus was entered, but many of the dogs



10 (32 days)

11 (94 days)

12 (7 days)

FIG. 4.—See legend under Fig. 1.

notwithstanding died of empyema thoracis. Our present knowledge of pleural infections is small. For instance, a few years ago in a laboratory in which I was working, two well-trained surgeons had performed a large series of lobectomies on dogs. They did them in the same laboratory with the same technic, but about eight months apart. The first surgeon did not lose a dog and the second did not save one. It was not a matter of epidemic distemper or mange either. But it was one of infection. Why? None of us could say.

CONCLUSIONS

1. End-to-end anastomoses of the œsophagus yield an uncertain percentage of successes.
2. When the operation is successful, the anatomical and physiological results are good.

‡ Done in the Laboratory of the Medical School of the University of North Carolina, but not reported.

3. Any marked stricture at the site of operation can be avoided by doing the anastomosis with the viscus fully expanded.
4. Unabsorbable suture material is probably more satisfactory than catgut, though resulting in the formation of marginal ulcers.
5. Scrupulous asepsis is of the first importance in the chest.
6. The prevention of pneumo-thorax at the closure of operation is essential.
7. The development of efficient chemo- and bio-therapy for the control of pleural infection would do most to make operations in this field return a constant high percentage of successes.

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MALIGNANT DISEASE OF THE THYROID GLAND*

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AND

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A DISCUSSION of any thyroid disorder must soon exhaust established facts and lead us into the depths of the unproven and the unknown, and a study of the malignant aspect would perhaps, at first glance, seem especially fitted to disclose how little we really know about the physiology and pathology of this gland. In many ways our knowledge of thyroid malignancy is incomplete. The true incidence of the disease (in relation to total population, goitrous population, nodular goitre, and geographical goitre belts) has not been worked out; the mortality rate is unknown; the etiological importance of heredity, pregnancy, trauma, infection, and hyperthyroidism, has yet to be established; the histology is still under discussion; the effectiveness of radiation is a debatable point; and methods of treatment are varied and conflicting. And yet, through the Hippocratic process of accurate case reporting, there has gradually accumulated a body of fact which is far from negligible and which offsets to an appreciable degree the undeniable deficiencies in our knowledge.

These records have been rendered accessible and significant to us by the careful analyses and summaries which have been made from time to time by able students of the subject. The most comprehensive reviews are those by Ehrhardt (1902), Müller and Speese (1906), and Wilson (1921).

In his paper, in which he added 290 new cases to the 1140 already reported, Wilson remarked upon the paucity of material from this continent and urged clinicians to bring forward for the common advancement the results of their experience. In what literature has been available to us, we have found reported since Wilson's paper 432 cases, the majority of which have been contributed by surgeons and pathologists. With the 14 new cases reported from the Montreal General Hospital, the total number of cases reviewed in this paper is 1876.

Not only have there been additional reports since Wilson's paper, but decided advances in our knowledge of the subject have been made. The more striking of the newer conclusions will be briefly indicated.

Pathology.—Although many writers (Herbst, Graham) include cases of *sarcoma* in their reports, Ewing is doubtful whether its existence has been fully established. Zeckwer reports a case of fibro-sarcoma which will perhaps help to settle the dispute; in his specimen, he states, the fibrils were demonstrated histologically by accepted methods of differential staining.

The growing disbelief in "benign metastasizing goitre" was strength-

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ened by Delannoy and Dhallium's conclusion from an analysis of 72 cases so classed, that few, if any, of the cases had been proved to be benign. This view is shared by Simpson, who urges that, since there is abundant proof of the non-existence of "benign metastasizing goitre," the term should

	Cases
Wilson	1430
Graham	134
Breitner	103
Simpson	55
Craver	33
DeCourcy	24
Klose and Hellwig	20
Porter	19
Walton	13
Hueck	9
Eisen	7
Wolff	3
De Quervain	2
Greenfelder and Bettman, Meleney, van Rijssel, Roeder, Delannoy and Dhallium, Kamsler, Kraus, Ashhurst and White, Luney, Zeckwer, each one	10
	432
Montreal General Hospital	14
	1876

be dropped. Further support for this attitude is found in the writings of Berard and Dunet, who, with a logic that is typically French, maintain that, even though it is not demonstrable, the primary lesion must be in the thyroid gland.

Graham undertook a review of a large series of malignant cases (134) in the hope of finding better criteria for the histological differentiation of benign and malignant neoplasms. The classical evidence of malignancy, namely, local infiltration, modified cell structure, and karyokinesis, he believes to be inadequate in the diagnosis of certain thyroid neoplasms. The striking observation was made that, by the test of freedom from recurrence, either local or metastatic, 43 tumors which had been classed as malignant, but in which no invasion of blood-vessels by tumor cells had occurred, proved to be benign. On the other hand, invasion of blood-vessels was found in every case which exhibited in its later course clinical evidence of malignant disease. This led Graham to conclude that vascular invasion was the most pertinent histological characteristic of a malignant thyroid neoplasm, and that the most constant single indication of malignant disease was the invasion of blood-vessels by tumor cells.

Endothelioma must be given a place among the malignant neoplasms of the thyroid, and current conceptions have been enlarged and clarified by De Quervain's clinical and pathological study under the name of "Struma Maligna Endotheliomatosa". De Quervain believes that this tumor always begins as a localized lesion in the thickened wall of an old cyst.

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Roeder collected 10 cases of *epithelioma of the squamous cell type*. The occurrence of malignant degeneration in benign tumors was made a special study by Speese and Brown.

It would be well here to refer to a rapidly growing tumor occupying the border line between hyperplasia and malignant growth, namely, the *proliferating adenoma* first described by Langhans. The nodules are large, circumscribed, unilateral, rapidly growing, of increased consistence but of normal mobility. Histologically they are composed of solid cellular plaques, arranged parallel to the capsule at the periphery but toward the centre curled upon themselves. With the onset of malignant change the plaques become large and irregular, the capsule and blood channels are invaded, and karyokinesis becomes abundantly evident.

In his paper in 1925, Craver discussed the subject of *parathyroid malignant tumors* and their differential diagnosis. He describes them as small, hard, deeply situated, fixed nodules, attached to one lobe of the thyroid. They develop in slowly growing goitres, are accompanied by dyspnoea, hoarseness, and dysphagia, and do not grow downward toward the clavicle.

Without casting a doubt upon the accuracy of the observations of Klose, Kolodny and others, who have described *metastatic hypernephromas* in the thyroid, a cautious pathologist may well hesitate to pronounce a given specimen a hypernephroma unless the primary tumor can be demonstrated.

While it is true that in the thyroid there are found tumors with a delicate reticulum, vascular channels of a definite type, and large pale quadrilateral cells with small nuclei arranged in groups of fairly equal size, it is perhaps unwise to conclude that they all arise from hypernephromas. One case in our series, reported as a carcinoma (No. 434), presents such a picture in many areas, but careful analysis of other parts of the specimen and the absence of clinical signs of hypernephroma justify the opinion that it was an epithelioma of thyroid origin. Several illustrations in Wilson's paper show sections of tumor which, in certain fields, closely resemble Grawitz tumor.

Metastases may make their appearance before the original tumor has been detected (Breitner 4 cases, our series 1 case, No. 389). Walton states that metastases often appear very early and are no contra-indication to operation. Authorities are at great variance as to the commonest site of metastatic implants and the frequency of their occurrence. Kraus, whose series is supported by a large percentage of autopsies, reports the finding of metastases in 90 per cent. of his cases.

Metastases to bone have been widely studied. The bone-destroying and bone-forming potentialities of the implants are well known. Joll collected a series of 44 cases of bone metastases associated with normal thyroid or benign goitre. Simpson reviewed 77 cases and, as already noted, his studies led him to believe that the benign nature of the primary growths had not been proven.

True metastases must be distinguished from carcinoma in lateral "aberrant" thyroid tissue, instances of which have been reported by Greensfelder and Bettman, Kamsler, and others.

Therapy.—The value of radiation in malignant thyroid disease is a subject of much discussion at the present time. The opinion of Oehler, that the diagnosis of malignant goitre may be verified by the absence of the tracheal shadow in X-ray plates, has been shown to be unreliable by Klose and Hellwig, who quote as authority the writings of Pfeiffer.

Schaedel's belief that thyroid carcinoma is sufficiently radio-sensitive to make exposure a "therapeutic test" has not been widely supported. His statement is that proper exposure of a true cancer to X-rays leads to softening and diminution in the size of the growth in from two to three weeks.

Sarcoma in the thyroid was found by Schaedel to be particularly resistant to X-rays, but Perthes considers the outlook here to be as favorable as elsewhere. According to Schaedel, the primary tumor is more sensitive to radiation than are the metastases arising from it.

Holfelder and Sudeck both state that thyroid malignant neoplasms show greater radio-sensitiveness than do other malignant tumors; and Breitner believes that adeno-carcinoma of the thyroid is more susceptible to radiation than are the other varieties of thyroid carcinoma.

Sudeck, DeCourcy, and others believe that, whenever a clinical diagnosis of malignancy has been made, operation should be withheld and radiation alone employed. Perthes, however, speaking from a very broad experience, recommends radiation as an adjunct to surgical treatment, and in this view he is supported by Holfelder, Werner, Holzknecht, and others.

ANALYSIS OF FOURTEEN CASES FROM THE MONTREAL GENERAL HOSPITAL

Incidence.—The records of the Goitre Clinic at the Montreal General Hospital (1920-1926 inclusive) cover 1687 cases of goitre, of which 612 were operated upon. Of these 612 cases, 346 were of the adenomatous type. Fourteen cases were malignant, that is 0.8 per cent. of the total number of cases, 1.8 per cent. of the operative cases, and 3.1 per cent. of the adenomatous cases operated upon. These percentages agree fairly well with those of other goitre clinics.

Age.—The youngest was fifteen, the oldest fifty-nine. The average age was forty-three years. There were more in the sixth decade than in any other.

In Wilson's series a majority were found in the fifth decade, and Breitner points out that in his series of 103 cases 75 per cent. had passed the age of greatest physiological activity of the thyroid and sex glands.

Sex.—There were twelve females and two males, a ratio of 6 to 1. Most writers agree with Wilson that the ratio is more nearly 2 to 1. Breitner had 62 females and 41 males, an unusually high percentage of males.

Considering that, in the 346 cases of nodular goitre operated upon in our clinic, the females outnumbered the males by 9 to 1, there seems to be evi-

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dence that a greater proportion of male goitre cases develop malignancy than do females (5.8 per cent. of males, 3.8 per cent. of females).

Heredity.—A history of goitre in ancestors was absent in all cases. Three cases had relatives with goitre. Of other forms of malignant disease in the family there were none in our series. Breitner mentions four instances in his series of 103 cases, and Wolff tells of the occurrence of malignant thyroid disease in two brothers.

Pregnancy.—Eight of the twelve women in this series had been pregnant. As most married women become pregnant, however, the importance of pregnancy as an etiological factor requires careful examination. Walton points out that, not only may we expect a parenchymatous enlargement of the gland during or following pregnancy, but that simple adenomas often become larger and harder at this time. In Breitner's paper, however, there is the report of a case in which the onset of the malignancy seems to coincide with the onset of pregnancy. Speese and Brown also quote Kaufman in support of this occurrence.

Infection.—A history of infection was not met with in this series, but it is mentioned by Carrel-Bellard, De Quervain, Speese and Brown, and others, as having been present in the history of many cases. The infections reported occurred both in the thyroid itself and in distant regions, and the French writers are particularly insistent upon the frequency of naso-pharyngo-tonsillar infections as an etiological factor.

Trauma.—Trauma is mentioned fairly constantly by European clinicians, and in one of the cases here reported trauma preceded the development of a growth which proved fatal in a few months (No. 943).

Duration of the Thyroid Swelling.—An increase in the size of the gland was found in all of the fourteen cases of this series. The average duration was eleven years, the minimum one month, the maximum forty years. In only four cases had the swelling existed for more than one year.

The term "acute cancer", used by Craver (who quotes Ewing, Moure and Liebault, and Bowman), designates those rare cases in which growth is amazingly rapid and suffocation threatens within a few weeks of onset. One of our cases has been placed in this class (No. 943).

Previously Existing Thyroid Tumor.—In support of the previous existence of thyroid tumor in most cases of malignant disease, if not in all, the opinions of a decisive number of authorities can be cited—Speese and Brown, Wilson, Plummer, Balfour, Berry, Walton, Graham, Klose and Hellwig, and Bland-Sutton. Balfour goes so far as to state that cancer is practically not known to have developed in a previously healthy thyroid gland. Graham states that 90 per cent. of malignant thyroid cases originate in a preëxisting simple or adenomatous goitre.

A history of preëxisting goitre was elicited in 12 cases of our series. In the other two cases it could not be determined from the history whether or not there had been an earlier lesion.

Of the twelve definite cases of preëxisting goitre, five were thought to have been of the adolescent type and seven of the nodular type. Our feeling is that all of these cases were primarily endemic, secondarily benign adenomas, and finally malignant.

There is, however, considerable evidence in favor of the development of carcinoma in the normal gland. Ewing admits its possibility. Hinters-toesser's seventeen cases of diffuse infiltration and the well-known peculiarities of the scirrhous group provide a basis for the claim on purely pathological grounds. The clinical studies of Walton, Breitner, and others, include cases of primary cancer. Breitner believes that, in eleven of his cases of carcinoma, the thyroid gland was previously normal. The majority of his cases were males in the fourth decade, with a tumor history of only four months' duration. Fuller data will probably show that this primary type of cancer does occur, but that, in comparison with the number of carcinomas which arise in previously existing lesions, its development is very rare.

Pain.—None of the cases in this series complained of either local or referred pain. Breitner and others mention painful sensations in the distribution of the cervical sensory nerves.

Emaciation occurred in three cases. Unlike other cancerous growths, thyroid malignancy is rarely accompanied by emaciation. In estimating the rate of failure of nutrition, it is necessary to bear in mind the fact that hyperthyroidism may also be present and, as in our cases, may be the cause of considerable loss of weight.

Nerve Lesions.—One case showed paralysis of one vocal cord. This is believed to have been due to interference with the recurrent laryngeal nerve. Walton reminds us that this may result from a benign tumor. In one of Schaedel's cases there was partial motor paralysis of one arm.

Deformity of the Trachea.—In six of our cases the trachea was shown by X-ray to be deviated from its normal position. In three cases it was narrowed from side to side. Records of tracheal invasion with hemorrhage and pneumonia are presented by Bland-Sutton and Müller and Speese.

Dysphagia was a symptom in one case. Wilson believes that in the early stages it is due to spasm and in the later stages to pressure. Breitner found dysphagia present without dyspnoea or hoarseness. Berry points out the rarity of this symptom in innocent goitre. He observed dysphagia most often in those cases in which the malignant process was situated in the posterior part of the gland.

Interference with breathing occurred in six cases. Breitner found this to be the commonest clinical symptom. This embarrassment to normal respiration must be distinguished from the dyspnoea which accompanies exertion in cases of hyperthyroidism or cardiac weakness. In thyroid malignancy the dyspnoea is due to compression and fixation of the trachea or to œdema and invasion of the larynx.

Rapidly growing thyroid tumor was observed in four of our cases. While there is a wide difference of opinion as to what constitutes rapidity

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of growth, this term is constantly employed and is useful. In each of our cases the entire growth period was less than one year and the resulting tumor was of considerable size. Herbst includes in this class 25 per cent. of his cases. Wilson, on the other hand, states that rapidity of growth is not necessarily indicative of the existence of malignancy nor of its degree. Loss of fat tissue in the neck emphasizes growths previously inconspicuous or reveals those hitherto unsuspected.

Walton summarizes the causes of rapid increase in size as follows: (1) Proliferation of tissue, (2) hemorrhage, (3) inflammation. It is well to recall that hemorrhage or inflammatory change may occur in benign as well as in malignant tumors.

Hoarseness was not observed in any of our cases. In the literature it is mentioned often, and the causes are set down as paralysis of the muscles of phonation, cancerous invasion of the vocal apparatus, or œdema of the cords. The onset may be quite sudden and without increase in the size of the tumor (Breitner).

Fixation.—In four of our cases the tumor was fixed to its surroundings and in one case it was fixed to the trachea. This latter feature has often been noted, and Walton insists that it is a sign of paramount importance.

Consistence.—The hard "woody" feel of cancerous masses has often been commented upon, but Berry aptly remarks that most small nodules in the thyroid gland are not malignant. Many are calcified adenomata.

Hemorrhage into the tumor was not noticed in this group of cases. It does occur, however, and may account for a sudden increase in the size of the tumor, with respiratory obstruction. Hemorrhage of itself is not a proof of malignancy (Berry). Breitner mentions profuse hemorrhage from the œsophagus and trachea, and in simple adenomatous goitre hemorrhage is the most common cause of sudden enlargement, occasionally producing death from suffocation.

Cardio-vascular changes were present in five of our cases. The mildest deviation from normal was a transient basal systolic murmur. Three cases had hypertension, tachycardia, and a systolic murmur at the base, and in one patient auricular fibrillation and left preponderance had been present for years.

Hyperthyroidism.—Three of our cases had an elevated basal metabolic rate. Walton, Klose and Hellwig, Wilson and Plummer, all subscribe to the statement that hyperthyroidism may be the first sign of malignant change in a benign goitre. Walton removes all nodules which are accompanied by a sudden onset of hyperthyroidism, on the assumption that they will ultimately prove malignant. There is as yet no agreement about the frequency of the occurrence of hyperthyroidism in malignant disease of the thyroid. With the adoption of an elevated basal metabolic rate as the most reliable index of hyperthyroidism, the percentages have tended to rise. Herbst gives 3 per cent., Boothby 22 per cent., and Simpson 50 per cent.

Graves' Disease.—There was in our series only one case with the full

Graves' syndrome. The final diagnosis of this case is still in doubt. The tranquil post-operative course and the fact that, two years and one month after operation, the patient is still alive and well, make it seem probable that the morphological picture has led to a false conclusion. Ewing is the authority most often quoted for the statement that the symptoms of Graves' disease may appear during the development of a malignant tumor and that the characteristic hyperplasia of Graves' disease may go on to malignant growth. Herbst, however, failed to find one case of cancer in 5867 cases of exophthalmic goitre.

There were two other cases in our series which exhibited a slight lagging of the upper lid and a widening of the palpebral fissure, but in neither case was there a stare or exophthalmos.

Point of Origin of the Malignant Process.—Klose and Hellwig are supported by other European writers in the statement that malignant change originates more often in the right lobe than in the left.

Metastases were noted in four of our cases. They occur perhaps more frequently than one would conclude from reports; in 14 of Breitner's cases they were missed clinically and detected only at autopsy. In our cases they all occurred in the tissues or lymph-nodes immediately surrounding the thyroid.

Recurrences took place in four of our cases. This is a common experience. In three of these cases a previous operation had been performed elsewhere.

Invasion of Blood-vessels.—Although in this clinic the invasion of blood-vessels has been looked for only since the appearance of Graham's article, it has been demonstrated in four of our more recent cases, one of which has since died. The gross invasion of large vessels has, of course, always been recognized, and Breitner includes seven cases in his series.

Other venous lesions are (1) venous stenosis and thrombosis (Craver); (2) venous invasion where the tumor capsule is intact; and (3) venous invasion by a histologically benign tumor (Ewing).

Clinical Diagnosis.—Only six of the cases included in this report were diagnosed clinically (four advanced), a percentage corresponding with those given by other observers. Some solace is found in De Quervain's statement that, "when malignant degeneration exists in a well-encapsulated goitre, clinical diagnosis is out of the question." Balfour's statement, that the majority of cancers develop deep in the gland and not at the surface, also accounts for many failures. Balfour's observation coincides with our own experience.

De Quervain points out that, in a non-pregnant patient past the age of thirty, rapid growth in a goitrous nodule should arouse suspicion. Walton stresses the irregularity of outline, the increase in consistence, and the development of signs of hyperthyroidism, but Klose and Hellwig think that the mass need not be nodular, and Friedland describes a series of carcinomas without any enlargement of the gland.

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There is, of course, no difficulty in diagnosing a tumor which grows rapidly, is fixed and hob-nailed, causes pain, and is associated with glandular enlargement; but the writings of Kocher and Berry suggest that few clinicians have the refinement of diagnostic skill necessary to detect the early cases or to determine whether or not there is malignant change in small nodules. Undoubtedly, were the examination of patients less perfunctory, more cases would be recognized or suspected before glandular metastases had occurred.

With regard to local recurrences, we now take the view that a nodule developing in a lobe upon which a previous enucleation resection has been performed, with negative histological findings, should be considered malignant until proved otherwise.

Diagnosis at operation was made in two of our cases. The likelihood of an accurate diagnosis being made at operation in hitherto unsuspected cases is rather meagre.

Histological Diagnosis.—Four of our cases were diagnosed histologically, and two were overlooked by the pathologist and recognized later by recurrences. The importance of skill and vigilance in the microscopical examination of all tissue removed can not be over-estimated, and, although errors of omission and commission do occur, the progress of histological diagnosis is decidedly in the direction of greater efficiency.

Differential Diagnosis.—Berry, De Quervain, and Kraus, agree that the most difficult clinical differentiation is that between thyroid malignancy and chronic diffuse thyroiditis. In the latter condition there is a dense, uniformly hard swelling, of moderate size, generally unilateral at first, but soon involving the whole gland. The gland moves freely on deglutition, is usually somewhat fixed to the trachea, nearly always painless, and practically without symptoms. The two most important differential points are: (1) the smoothness of the surface of the gland, the normal shape being retained, and (2) the early waxy pallor of the patient (myxœdema). Dysphagia is rare.

Tertiary syphilis may be excluded by the clinical history and the Wassermann test.

Tuberculosis is rare. In its nodular form the foci undergo softening and form abscesses. In one of our clinic cases, a woman with an enlarged thyroid, indurated glands in both posterior triangles, and an elevated basal metabolic rate, malignancy was suspected. A resected lymph-gland was shown to be tuberculous, and the thyroid nodules on resection were found to be simple adenomata.

Worthy of note are those cases cited by De Quervain of old cystic goitres with thick walls, in which hemorrhage or metastatic infection had occurred.

In the absence of fever or leucocytosis, immobility in a tumor and a recent increase in size should, in patients over forty, raise suspicions of malignancy.

To Trotter we owe a pertinent discussion of the differential diagnosis

between carcinoma of the cervical œsophagus and thyroid gland malignancy. He states that in œsophageal cancer there is first weakening of the voice; secondly, enlargement of the thyroid gland due to induration of its posterior surface; and thirdly, œsophageal symptoms. A case observed at the Montreal General Hospital in 1923 supports this view. A man, aged fifty-eight, was forced to give up his occupation as an announcer and interpreter in a cinema on account of loss of voice. Physical examination revealed a hard enlargement of the thyroid gland and œdema of the vocal cords. Barium films of the œsophagus were negative. He failed rapidly and died, and at autopsy a small carcinoma was discovered in the œsophagus, with metastases about the larynx and in the thyroid.

We are indebted to De Quervain also for the following remark in regard to differential diagnosis: "Operation must never be delayed until all the signs of malignancy are present, because the aim is not diagnosis, but cure. The prognosis in malignant goitre is favorable only so long as the growth is within the capsule of the goitre, and malignancy must, therefore, be suspected rather than diagnosed."

Treatment.—Opinions on treatments are very varied. Kocher states that a "really early" operation will cure from 80 to 90 per cent. of cases, but the value of this statement depends upon what is meant by "really early". Balfour and DeCourcy think that, if a clinical diagnosis can be made, there is little hope in operation alone, and advise radiation too. There are advocates of radiation alone who claim results superior to those achieved by surgical removal. Others, again, believe that radiation alone should be used only in inoperable cases; Breitner had six cases who lived for more than three years and Weber also reports successes. The experience of Heyerdahl with radium alone (eight cases, of which five were improved and three unimproved) compares unfavorably with the results obtained by others. Pfahler advocates radium if X-ray fails.

Most surgeons agree that, in the conduct of reasonably early cases, the "golden middle way" is thorough operation followed by radiation, the only controversial points being the extent of the operative procedure and the variety and amount of radiation. Breitner's post-operative use of frequent and small doses of X-rays is in contrast to the more recent recommendation of large doses with long intermissions.

Sixteen operations were performed upon 11 patients in our series:

Unilateral lobectomy	6
Subtotal thyroidectomy	4
Unilateral lobectomy and removal of metastases	2
Excision of metastases	2
Bilateral partial lobectomy	1
Bilateral partial lobectomy and removal of glands	1

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16

Tracheotomy was not performed in any case.

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<i>Operative Results.</i> —Operative death	0
Deaths since operation	2
Not seen since discharge	1
Living	8
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	11

Of the cases who were not operated upon, one died three weeks after discharge from sudden suffocation after going upstairs; one did not return to the clinic; and the third (an out-of-town case) has not been heard of since examination. Both are presumably dead.

Of the eight cases known to be alive (57 per cent.) the post-operative period varies from five weeks to five years.

Less than one year post-operative	3
Between one and two years post-operative	1
Between two and three years post-operative	2
Between four and five years post-operative	2
	—
	8

It would be hazardous to pronounce any of these cases complete cures, but in a few of them the results are extremely gratifying. Simpson finds that the five-year period is not long enough to pronounce a cure.

Craver found that the average age at diagnosis of those cases who died was higher than that of the living and the average duration of the tumor was also much greater in those who died than in those who survived.

A second operation was performed in two of our cases, and a third operation in one case. This last patient is still alive, four years and two months after the first operation, and is at present without evidence of disease.

<i>Histological Classes</i> —Malignant adenoma	2
Carcinoma	8
Malignant papilloma	1
No histological diagnosis	2
Doubtful	1
	—
	14

If sarcoma does exist in the thyroid gland, it is certainly the most deadly of the histological varieties of malignant disease. Of those cases reported by Breitner not one survived more than four months, and, in spite of sundry opinions to the contrary, sarcoma would seem to be less radio-sensitive than are the other malignant neoplasms in this organ.

Both of our cases of malignant adenoma are alive, the one—three months after operation, the other—one year after. Herbst found that 17 per cent. of his cases lived at least five years.

Of the cancer cases four are alive and four are dead. The living cases are from two months to five years post-operative. Herbst reports 5 per cent. of five-year cures in this class.

Malignant papilloma is regarded as the least malignant variety, and of

these Herbst reports 33 per cent. of five-year cures. The case reported here is alive, but only two months have elapsed since operation. Malignant papilloma is said to grow slowly, to give rise to small local recurrences, and to involve the lymph-nodes very late.

The case of exophthalmic goitre in this series (No. 1045), with hypertrophic parenchyma profusely invaded by epithelial masses, extensive vascular invasion, intense lymphoid reaction, and a deeply embedded adenoma (treated by subtotal thyroidectomy in two stages), is still alive and well, two years and one month after operation. The correctness of the histological diagnosis of malignancy must now be considered doubtful.

CONCLUSION.—During the past five years progress has undoubtedly been made in the diagnosis and treatment of malignant disease of the thyroid gland, but, where the condition is advanced and there is infiltration of the surrounding structures or extensive cervical glandular metastases, there is still little hope of a permanent cure. The results obtained, however, in those cases operated upon under suspicion of malignancy or in those in which unsuspected malignancy is discovered at operation, are distinctly more encouraging. Still better results may be confidently forecast from the extension of our knowledge of radiation, its more general use in those cases in which the malignancy is recognized or discovered before the occurrence of metastases, and the more frequent and early removal of nodular goitres.

CASE REPORTS

(1) Clinic number 389. Male, aet. fifty-seven. Admitted May 12, 1922, complaining of palpitation, weakness, and loss of weight. He gave a history of having had "a small gland" removed from the left submaxillary triangle one year previously. Emaciation, tremor, rapid irregular pulse, and muscular weakness were the outstanding clinical features. The basal metabolic rate was +47. Weight, 133. The electrocardiogram showed auricular fibrillation. There was a movable, globular mass, 6 cm. in diameter, occupying the lower pole of the left lobe of the thyroid. Clinical diagnosis: toxic adenoma.

On June 1, 1922, under local anaesthesia, enucleation resection of the left lobe was performed. Pathological diagnosis: "Adenoma".

Following operation the tachycardia subsided and the basal metabolism fell to normal. The patient returned to work on September 5, 1922, as a hydrant inspector. By November 15, 1922, the weight had risen to 190 pounds. In September, 1924, he began to lose weight. On October 23, the basal metabolism was found to be +58, and on November 6, +78. At this time the appearance of enlarged glands on the left side of the neck was first noted. Later they were found on the right side.

The patient was re-admitted on December 18, 1924, and bilateral dissection of the lymph-glands of the neck carried out under local anaesthesia. The left internal jugular vein was removed. Pathological diagnosis: Adeno-carcinoma of thyroid origin. X-ray treatments.

The patient remained well for eight months. He was then admitted with failing circulation and gangrene of the feet. Died December 5, 1925. No autopsy.

(2) Clinic number 414. Female, aet. fifteen. Unmarried. Admitted January 7, 1923. History of goitre at age of ten, which disappeared on application of iodine, but recently recurred. On admission there was general enlargement of the gland, with

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an adenoma in the upper pole of the right lobe. There were no symptoms of hyperthyroidism. The basal metabolism was minus 5. Diagnosis: Adenoma non-toxic.

Operation January 12, 1923, under local anaesthesia: Bilateral partial lobectomy, an adenoma being found in the left lobe as well. Pathological diagnosis: Multiple adenomata. Uneventful recovery.

On October 22, 1924, the patient returned, complaining of a lump in the neck, present for three months. On examination there was found a mass $2\frac{1}{2}$ -3 cm. in diameter in the right anterior triangle, on a level with the hyoid bone, freely movable, but no movement on swallowing. Temperature $99\frac{1}{4}$. The possibility of a tuberculous cervical adenitis was at first considered. The tonsils were cryptic. There was general pyorrhœa. On November 19, 1924, the mass was noted to be definitely larger.

On January 6, 1925, under local anaesthesia, a number of glands with infiltrated capsules were removed from the right anterior triangle. On section these glands suggested thyroid metastases. This diagnosis was confirmed in microscopic sections. This operation was followed by X-ray treatments.

On April 22, 1925, there were palpable glands to be made out along both jugular veins, more marked on the left side at the level of the thyroid. Up to this time the patient had had six X-ray treatments. On October 2, 1925, the glands on the left side were noted to be larger and admission was advised.

On December 26, 1925, the patient was re-admitted, and on December 31, under intratracheal insufflation, all glands from the base of the skull to the clavicle were removed on the right side, together with the remnant of the right lobe and isthmus, as well as the internal jugular vein. In addition the remnant of the left lobe was explored and a portion removed. The thyroid tissues removed showed microscopically adeno-carcinoma. The lymph-nodes removed were free from metastases. Recovery uneventful. X-ray treatments have been continued. The patient is alive and well, four years and two months after the first operation.

(3) Clinic number 426. Female, aet. fifty-three. Married. History of goitre of seven years' duration. Clinical diagnosis: Adenoma of the right lobe. No toxic symptoms.

On March 25, 1922, under local anaesthesia, practically the whole of the right lobe was removed from within the capsule, together with a gland attached to its lower pole. Histological diagnosis: Carcinoma of the thyroid, with complete replacement of lymph-nodes with thyroid tissue. No X-ray treatment. Has remained well (five years after operation).

(4) Clinic number 434. Female, aet. twenty-eight. Unmarried. Admitted April 18, 1923. History of adolescent goitre, developing at the age of fourteen and slowly increasing in size. Previous operation elsewhere six years before. On examination there was found moderate enlargement of the left lobe, with fixation. Patient underweight. No toxic symptoms. Diagnosis of carcinoma made before operation and confirmed by pathological examination of tissue removed.

Operation April 23, 1923, under intratracheal insufflation. Removal of left lobe, with dissection of neck and removal of internal jugular vein. The growth was found to be adherent to the left side of the trachea, to the margin of the œsophagus, and to the pre-thyroid muscles on the left side. The latter were removed. Uneventful recovery. Discharged May 5, 1923. Not heard from since. No response to follow-up letters.

(5) Clinic number 689. Female, aet. fifty-two. Married. Admitted August 14, 1923, with enlargement of the thyroid of two and a half months' duration. Pressure symptoms had been present for six weeks and there was frequent cough. There had been a loss of twenty-six pounds in weight in four months. Diagnosis of carcinoma was made before operation.

Operation was performed August 21, 1923, for relief of pressure, subtotal thyroidectomy under local anaesthesia. Evident involvement of the mediastinal glands. Clinical

diagnosis confirmed by microscopic examination. X-ray treatments given. Patient died some months later.

(6) Clinic number 943. Male, aet. forty-nine. Admitted November 12, 1924. History of blow on neck five months previously, followed by rapidly growing hard tumor of neck. Clinical diagnosis: Carcinoma of the thyroid. Confirmed by microscopical examination of a gland removed from the left posterior triangle of the neck. The growth was advanced. Trachea fixed. There were stridor and paralysis of one vocal cord. No operation. Died suddenly three weeks later, from suffocation after going upstairs. No autopsy.

(7) Clinic number 994. Female, aet. fifty. Married. Admitted January 7, 1925, with a small nodular enlargement of the thyroid, extending down behind the manubrium. Very little movement of the trachea on swallowing.

Enlargement first noted only four weeks before admission. Clinical diagnosis: Carcinoma, inoperable. X-ray treatments advised. Patient did not return to the clinic. No response to follow-up letters.

(8) Clinic number 1014. Female, aet. thirty-eight. Married. Admitted November 12, 1925. History of goitre for two years. Diagnosis of carcinoma with lymph-gland metastases made at operation November 14, 1925. The isthmus and the left lobe, with capsule, parathyroids, and left recurrent laryngeal nerve, were removed, together with the left prethyroid muscles, the lymph-glands in the anterior and posterior triangles of the left side of the neck, and the left internal jugular vein. Uneventful recovery. Permanent impairment of phonation. Intermittent X-ray treatments. Living and well two years and four months after operation, with no clinical signs of recurrence.

(9) Clinic number 1045. Female, aet. forty. Married. Admitted December 10, 1924. History of goitre for five years. The patient presented all the symptoms of Graves' disease, in an exaggerated degree. The basal metabolism rate was +90. The thyroid was uniformly enlarged, the surface of the lobes smooth.

Right lobectomy was performed under gas-oxygen anaesthesia on February 11, 1925. In this lobe was found an adenoma, about 1½ cm. in diameter—a lesion not previously suspected.

On March 6, 1925, the left lobe was removed under gas-oxygen. The microscopic examination showed hypertrophic parenchyma profusely invaded by epithelial masses, with intense lymph-cell invasion and invasion of the blood-vessels. Diagnosis: Malignant. Uneventful recovery. X-ray treatments advised, but none given. The patient is well, more than two years post-operative.

(10) Clinic number 1048. Female, aet. fifty. Married. Admitted March 18, 1926. History of slowly growing goitre of forty years' duration, with dysphagia, stridor, and loss of weight during the previous year. The trachea was displaced to the left by a very large, hard, nodular tumor of the right lobe of the thyroid. The moderate degree of fixation seemed to be due to the size of the tumor. Clinical diagnosis: Carcinoma in previous simple adenoma.

Operation March 22, 1926. The whole of the right lobe was removed without injury to the recurrent laryngeal nerve. There were no enlarged lymph-nodes. Clinical diagnosis of malignancy confirmed by microscopic examination. Two X-ray treatments given before discharge. Patient has since remained well and free from evidence of metastases.

(11) Clinic number 1421. Female, aet. thirty-eight. Married. Admitted July 8, 1926, with a history of goitre for fifteen years. Partial removal five years ago elsewhere. Examination showed a very large nodular goitre, with deviation and displacement of the trachea to the left, with compression.

Operation July 13, 1926. Local anaesthesia. Bilateral enucleation resection. Malignant adenoma diagnosed histologically. Post-operative radiation.

Alive and well nine months after operation, without evidence of recurrence.

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(12) Clinic number 1772. Female, aet. thirty. Married. Admitted January 9, 1927. History of nodular goitre, of moderate size, for six years. Operation January 12, 1927, under local anaesthesia. Bilateral enucleation resection. Malignant papilloma invading blood-vessels discovered pathologically. No X-ray treatments to date.

(13) Clinic number 1771. Female, aet. forty-two. Unmarried. Admitted March 5, 1927, with a history of thyroid enlargement for thirty years. On examination there was found a freely movable, diffusely nodular goitre. Enlargement more marked during the last few months. There was moderate hyperthyroidism. The basal metabolic rate was +24. Operation March 10, 1927. Bilateral enucleation resection. Carcinoma of the left lobe suspected at operation and demonstrated in sections. Post-operative X-ray treatments.

(14) Clinic number 1773. Female, aet. fifty-seven. Married. History of adolescent goitre at fifteen, which receded. Goitre reappeared at age of thirty. In October, 1926, had operation upon the thyroid elsewhere. Examination showed a very large fungating necrotic tumor, extending across the front of the neck. Inoperable. No treatment. No histological examination. No subsequent report.

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THE SECONDARY SYMPTOMS OF EXOPHTHALMIC GOITRE (GRAVES' DISEASE)

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THE cases of exophthalmic goitre admitted to this clinic in the past two years have frequently failed to show the cardinal symptoms of the disease as generally stated. The cardinal symptoms occurring in their chronological order are, first: tachycardia; second: tremor; third: enlargement of the thyroid; fourth: exophthalmos. We have observed forty-two cases of exophthalmic goitre during this period. Of the cardinal symptoms exophthalmos is the least frequently encountered, as this makes its appearance fairly late in relation to the other complaints. This was absent in sixty per cent. of the cases. Enlargement of the thyroid was seen in seventy per cent. of the cases. In the very early stages the enlargement cannot be detected, but it may appear during the crisis and disappear in the remission. The other cardinal symptoms are constantly present in any case of exophthalmic goitre. The secondary symptoms are of more importance in making a diagnosis during the early stages of the disease than the above stated cardinal symptoms. For that reason more stress should be placed on these than has been done in the past.

(1) *Restlessness*.—This is frequently one of the early symptoms particularly noticed at the beginning of the disease. It is difficult for the patients to remain still, and during a conversation they are continually moving their hands and feet, or adjusting their clothing. The patients are usually unaware of their restlessness, but it is noticed by members of the family or friends. (2) *Irritability*.—Members of the family notice that the patient who before the onset of the disease had a very even temper, and maybe even a phlegmatic disposition, suddenly becomes very difficult to live with and constantly quarrels on the slightest provocation. The patient will tell you that members of her family cause her to lose her temper which never occurred before the start of the present condition. (3) *Emotion*.—The patient becomes very changeable and may cry or laugh from the slightest cause. This is not seen as early as the other nervous manifestations of the disease. (4) *Vaso-motor Disturbances*.—If the patients are carefully questioned one will find that they can stand much more cold than they could before the onset of the disease. They usually state that they wear less clothing than they did and are uncomfortable in a room which is comfortable to others. Their skin is moist and flushed. This becomes much more marked on the slightest exertion or excitement. (5) *Palpitation*.—This is a very distressing symptom. It is entirely different from tachycardia, and should not be confused with the latter. A normal individual is not aware of the heart action. Palpitation

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usually follows the slightest exertion and quite frequently comes on at night. It is also one of the factors in causing insomnia. This condition does not bear any relation to the severity of the disease, and the mild cases complain of this symptom as much or more than the severe types. (6) *Appetite*.—The usual complaint is an increase in the appetite. Patients who had only a fair appetite before the onset of the disease will complain of a ravenous one. In spite of the increased appetite they are steadily losing weight. Anorexia is occasionally complained of, but this is encountered in those cases that put on weight during the disease. These cases are seldom seen but do sometimes occur. We have encountered only two cases in which there was a definite gain in weight, one patient having put on twenty-five pounds and the other forty pounds, both being young females, the former twenty-one and the latter nineteen. Each diagnosis was proven by histological examination. (7) *Menstrual*.—The menstrual cycle is altered, the first symptom being a diminution at the time of the normal period. Later the time between periods lengthens and one may be skipped, and in the final stages the patient may have complete amenorrhœa. (8) *Sexual*.—The libido may be either diminished or lost. This is more often seen in males and is a very distressing symptom and frequently is the chief worry of the patient. Of course, this is transitory and will be relieved after the hyperthyroidism is cured. (9) *Insomnia*.—This is worse in the early morning hours. The patient falls asleep in the early part of the night but awakens after a few hours of sleep. Palpitation seems to be a factor in insomnia. This is not generally seen during the early stages of the disease. (10) *Muscle Fatigue*.—The patient frequently complains of being as tired in the morning as on retiring. Rest does not seem to relieve the exhaustion. Weakness of the extremities is sometimes seen, and occasionally a sudden giving away of the knees is encountered. The patient may drop while standing from no apparent cause whatsoever. (11) *Hyperhidrosis*.—The patients will complain of perspiring freely and are bothered more from their hands and feet than before the onset of the disease. Exercise or exertion does not seem to play any particular part in this condition. (12) *Pains*.—It is not uncommon for the patient to complain of vague pain in the extremities, joints and back, and this may be the primary factor for which medical relief is sought. I can cite one case whose chief complaint was referred to a sacro-iliac strain, for which he had worn numerous belts and braces for two years without relief. Since a thyroidectomy he has never had any complaints referable to the back and has been doing manual labor since five weeks following the operation, which was four years ago. (13) *Hoarseness*.—Quite frequently the patient will suffer from hoarseness, which seems to be due to a selective action of the thyroid secretion on the laryngeal nerves, producing a neuritis which will clear up following thyroidectomy. (14) *Falling of Hair*.—This is occasionally seen in the disease being confined as a rule to small areas of the scalp, and not affecting the entire coat of hair. (15) *Pigmentation of the Skin*.—Bronzing of the skin is seen. When encountered it is confined to the exposed portion of the body, chiefly the face, neck and arms, and is usually localized in patches.

PHLEGMONOUS GASTRITIS

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AND

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PHLEGMONOUS gastritis is a condition of very great interest because of its rarity and because of the high mortality. Brumm¹ was able to find two hundred and nineteen cases reported in the literature up to 1925.

Historically this condition has been known for a long time. Galen is said

to have described the condition. Shatara² stated that Benel in 1656 was the first to really describe the condition.

Pathologically the affliction is an acute purulent infection confined to the submucosa of the stomach, anywhere from the pyloric ring to the oesophagus and not usually extending beyond these confines. It may extend to the muscularis and the serosa but the mucosa is not usually involved. The affected portion of the stomach becomes markedly oedematous and the stomach wall may enlarge to four times the natural thickness. The serosa is



FIG. 1.—Condition at operation. Perforation in ulcer area. Purulent mass extruding.

injected and there may be a fibrinous exudate. The submucosa is distended by a purulent infiltration. The process may be either diffuse involving most of the stomach or it may be quite localized and circumscribed. The course of the condition usually terminates fatally in unoperated cases, death being due to general peritonitis or septicæmia.

Etiology.—Phlegmonous gastritis seems to affect males more than females, especially between the ages of twenty to sixty years. (F. Stöhr³.) Chronic alcoholism is a predisposing factor stressed quite frequently in the

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literature. Bacteriologically the most common offender was the streptococcus. This organism was obtained in pure culture from seventy-five per cent. of the cases reported in the literature; the rest were mixed infections with staphylococci, diplococci, *B. Coli* and occasionally the pneumococcus. (Brumm¹.)

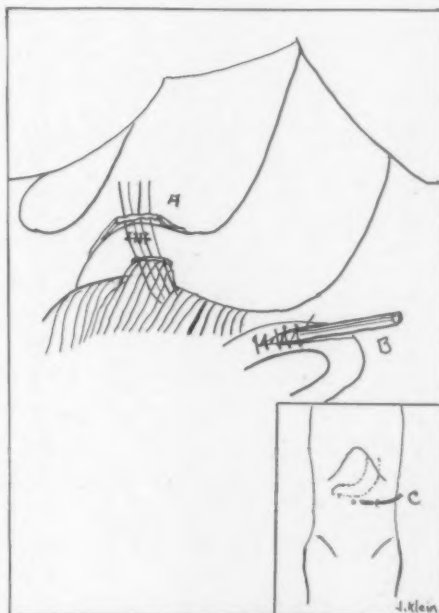
Pathogenesis.—The malady may arise from a local lesion in the stomach or through the blood stream. Brumm stresses the point that we see gastric phlegmon only where there is an absence or diminution of gastric acidity. This condition exists frequently in chronic alcoholism, carcinoma, chronic peptic ulcer, cirrhosis of the liver and severe anaemia. Thus twenty-five per cent. of the patients in the literature were chronic alcoholics. Brumm grew twenty-four-hour cultures in broth of virulent streptococci and placed some in normal gastric juice, some in hyperacid peptic secretion and some in anacid secretion. He found that the streptococci thrived in the latter secretions but were killed in the acid juices. This explains the failure of Shatara² to infect dogs by feeding them bacteria mixed with ground glass. The acidity of the normal gastric secretions prevented the infection. The disease may arise secondary to typhoid fever, scarlet fever, small-pox, puerperal fever, and even acute tonsillitis. (Brooks and Clinton⁴.)

"Phlegmonous gastritis may result either from some local process in the stomach, especially if there is low gastric secretion or from generalized bacteraemia. (Meyer, Brams and Guy⁵).

Symptomatology.—The onset usually is sudden with excruciating pain in the abdomen, vomiting, fever, and marked abdominal rigidity. Sometimes the patient vomits pus (Sundberg,¹⁰ Boas⁴); this is very significant but not common. (Meyer, Brams and Guy⁵.) The pain resembles that of perforated peptic ulcer. In short, the picture is that of an acute abdominal catastrophe and in only a few instances has the diagnosis been made during life. (Chvosok, Dörbeck, McCaske.)

"The disease so seldom comes within the domain of the practical surgeon that unless he has previously met with such a case he is unlikely to make any other diagnosis than that of some urgent condition in the upper abdomen requiring exploration." (MacCauley⁶.)

It is thought that the following case is of sufficient interest to be recorded



A. Suture of ulcer opening longitudinally. Gastro-hepatic and gastro-colic omentum being sutured over the ulcer area. B. Jejunostomy. C. Position of jejunostomy tube at the level of umbilicus.

because of some of the characteristic etiological factors as described above, because of the conservative surgery attempted, and because of the recovery of the patient.

CASE I.—Thomas Mickey, aged thirty-seven years, single, clerk. The patient was seized suddenly on the morning of May 12, 1927 with acute abdominal pain about the umbilicus. There had been some vomiting before the physician arrived. The patient was seen to be in marked shock and had the anxious look and gray pallor of a severe abdominal catastrophe. General physical examination showed alopecia areata, marked pyorrhœa, heart and lungs apparently normal. The abdomen, however, was very rigid with most of



FIG. 3.—T. M., June 6, 1927. Post-operative view of stomach and jejunostomy.

the rigidity over the right epigastrium. There was most marked tenderness on pressure over the right epigastrium, although patient complained bitterly of pain all over abdomen on palpation.

Past History.—The patient had been a faithful and steady user of alcohol for the past eight years. For the past six years the patient has suffered from periodic attacks of epigastric pain which was relieved by food taking and by soda. For ten days prior to the acute attack the patient had been feeling rather ill and had been vomiting but he had attributed this to the use of moonshine, of which he had been partaking liberally. On morning of acute attack he "felt something snap inside", then felt the excruciating pain which led him to call a physician.

Past Illness.—Scarlet fever as a child. Influenza in 1918. History of gonorrhœa and chancroid. Lues denied. Temperature ninety-six degrees. Pulse eighty. Respiration twenty-eight. White blood count 17000. Urine negative. Blood Wassermann (obtained afterwards) negative.

The high lights in this clinical picture are: history of alcoholism; apparent ulcer syndrome for the past six years, and the sudden onset of severe abdominal pain. A diagnosis was made of ruptured peptic ulcer.

The patient was immediately admitted to the Washington Park Hospital where under ethylene-ether anæsthesia the upper abdomen was opened by an incision in the right epigastrium. On opening the peritoneal cavity free pus escaped. Then it was noted that the upper abdomen was bathed in greenish-yellow pus, which seemed to be coming from under the liver and from the lesser peritoneal cavity. The gall-bladder was apparently normal, except for injection of the serosa and plastic exudate. On examining the stomach it was found to be markedly thickened and œdematous, especially in the pyloric portion involving at least half of the stomach. On the lesser curvature near the pyloric ring there was evident a markedly indurated area the size of a half-dollar in the centre

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of which was a perforation from which was half extruded a necrotic plug of material similar to that seen in a furuncle. On removing this plug of necrotic material pus exuded from the submucosa and it was seen that the mucosa was lifted up and rolled over but not otherwise affected. The stomach wall at the site of the perforation measured about one inch in thickness. A portion of gastro-colic omentum was found plastered down over part of the indurated area, an attempt at a natural defense. Because of the poor condition of the patient and the markedly œdematous stomach wall in the presence of an infected field, resection was thought inadvisable. The perforation was sewed over with interrupted sutures through the serosa and submucosa, attempting to invert same. The gastro-hepatic and gastro-colic omenta also were brought together covering the entire area that was indurated and again covered with a portion of the great omentum. Instead of performing a gastro-enterostomy we performed a jejunostomy after the Witzel method pulling up a loop of jejunum through a stab wound made at the level of the umbilicus and one and one-half inches to the left. A No. 18 French rubber catheter was sewed into the jejunum after the Witzel method. One drain was placed down to the foramen of Winslow, another down to the pyloric part of the stomach, and a third down to the pelvis. The abdomen was then closed in the customary fashion. Condition after operation fair.



FIG. 4.—T. M., June 6, 1927. Post-operative view of stomach and jejunostomy.

Course in the Hospital.—The patient vomited up some greenish pus for several days after the operation. His general condition seemed improved and he was relieved of his excruciating pain. In doing the dressings it was noted that the drainage material had a fecal odor, probably due to contamination with *B. Coli*. The jejunostomy tube was connected up with a Murphy drip apparatus and the patient was fed constantly through this. Following are some extracts from the hospital record.

May 13, 1927.—Temperature 100.2 degrees. Pulse 114. Respiration 28. Normal saline by drop method through jejunostomy tube. Patient vomited greenish pus frequently.

May 14, 1927.—Temperature 99 degrees. Pulse 84. Respiration 28. Glucose (5 per cent.) in normal saline through jejunostomy tube.

May 15, 1927.—Temperature 99 degrees. Pulse 64. Respiration 20. General condition good.

May 16, 1927.—Milk 500 c.c., water 500 c.c., Karo syrup 50 c.c., administered through tube.

May 24, 1927.—Water by mouth for the first time, one ounce every four hours.

May 26, 1927.—One ounce milk added to diet by mouth.

June 2, 1927.—Milk and cream, two ounces each given by mouth.

June 5, 1927.—Temperature 98.6 degrees. Pulse 80. Respiration 24. Discharged on the twenty-fourth day, feeling well.

The patient was now examined röntgenologically. There was hyper-peristalsis noted in the fluoroscopic examination. The region of the pylorus was still extensively scarred. (See X-ray films.) The jejunostomy tube was still in position in the jejunum. This was now taken out and the wound healed very rapidly. Subjectively the patient feels quite well and has been put on an ulcer régime.

Surgical procedure in phlegmonous gastritis will depend on the state



FIG. 5.—T. M., June 6, 1927. Post-operative view of stomach and jejunostomy.

of affairs found at operation. In the localized form resection is advised by various authors, the stomach then being united to the jejunum. (Meyer, Brams, and Guy.) In the diffuse form multiple punctures of the stomach wall is advised in the hope of permitting free drainage. A new procedure is recommended here, no mention of which is seen in the literature. Since death in this affection is due mainly to peritonitis and since it is rather difficult to drain the entire stomach submucosa by ordinary methods, it is suggested

that the stomach be brought out on the abdomen as is done in Mikulicz operations in malignancy of the colon. However, the circulation should be preserved intact; multiple incisions should be made in the submucosa and the stomach kept warm and moist with normal saline solution. This procedure would make some reasonable attempt at keeping the infection out of the general peritoneal cavity. The patient may be fed through a jejunostomy as was done above.

CONCLUSIONS

1. A case of localized phlegmonous gastritis is reported on the basis of an old peptic ulcer in the presence of chronic alcoholism and pyorrhœa. Closure of perforation, drainage, jejunostomy, recovery.

2. In the diffuse form it is recommended to bring the entire stomach out on the abdomen as in Mikulicz operations and multiple incisions for drainage

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be made, at the same time attempting to preserve the circulation. The patient should be fed through a jejunostomy.

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SIDE-TRACKING OPERATIONS FOR BILE DUCT OBSTRUCTION*

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THE side-tracking operations for common or hepatic duct obstruction is a palliative procedure designed to carry the bile into the upper gastro-intestinal tract in the presence of an irremovable duct obstruction or irreparable duct injury. The great majority of the unfortunate victims of such lesions are faced with a hopeless condition unless operated upon. If operated upon they are of necessity subjected to a procedure, the danger and difficulties of which increase in direct ratio to the duration of the complete obstruction. These patients have persistent deepening jaundice with accompanying symptoms of anorexia, loss of weight and strength and often unendurable pruritus. If the obstruction is of long standing their blood clotting time is prolonged, they have a narrowing margin of hepatic and renal efficiency and are altogether bad risks and yet as much in need of surgery as any group of abdominal cases.

These patients present three main types of lesions causing the obstruction. In the order of their frequency they may be grouped as follows:

1. New growths of the pancreas, common or hepatic ducts.
2. Chronic inflammatory lesions of the pancreas.
3. Stenosis of the ducts following trauma or inflammation.

For the side-tracking of the bile several methods have been used and in individual cases prove successful. But it should be strongly emphasized that the rare successes and not the many failures appear in the literature and the high risk and small chance of success are not sufficiently emphasized in the discussion of some of these methods. In general these may be grouped as follows:

1. The anastomosis between the gall-bladder and duodenum or stomach. Cholecystenterostomy is the easiest and most satisfactory of the procedures provided the cystic duct is patent and the obstruction is in the common duct below its junction with the cystic duct. Because of the relatively sterile duodenum and stomach, infection of the biliary tract is not so great a factor in these cases as when the stoma is made in the jejunum. For obstruction due to carcinoma of the pancreas or common duct the operation gives temporary relief. In one of our cases the patient survived two years, another three years with proven carcinoma of the common duct at the papilla. In the occasional case of chronic pancreatitis with complete obstruction, not associated with gall-stones, this operation is of special value. The stoma remains either as the permanent passage or until the inflammatory process in the head

* Read at the Meeting of the New York Surgical Society, April 27, 1927.

SIDE-TRACKING BILE DUCT OBSTRUCTION

of the pancreas subsides. It is in this type that biopsy is frequently the only means of differentiating between carcinoma of the head of the pancreas and chronic inflammation. In eight of the series here reported the diagnosis of carcinoma, from the history of gradually increasing painless jaundice, a palpable gall-bladder and the finding of a hard nodular head of the pancreas at operation, seemed certain. In three of these a section showed chronic pancreatitis. In the other five where section was not obtained a remarkable improvement with freedom from jaundice for periods of five months to two years made the diagnosis of carcinoma very questionable. In two of patients, autopsy at the end of two and three years proved the lesion to be carcinoma of the common duct. In the other three the diagnosis was never established though they died of pancreatic insufficiency.

Courvoissier's Law does not necessarily mean carcinoma and I believe these patients should be explored, section removed from the mass, if possible, for diagnosis and prognosis, and a cholecystenterostomy done for the relief it gives these patients even though it be temporary. From our experience common duct carcinoma is a less malignant lesion than carcinoma of the pancreas. The results as reported in other clinics:

For Carcinoma.—Kehr in a series of 71 patients with carcinoma of the pancreas in which he did the palliative cholecystenterostomy, and reported 10 of them alive after operation. It is not stated however that these were all proven cases by biopsy or autopsy. Guleke reports one of his cases died 2½ years after the operation.

For Chronic Pancreatitis.—Mayo-Robson reports a remarkable series of 102 cases of cholecystenterostomy for chronic pancreatitis with an operative mortality of only 3.9 per cent.

Kehr reported 8 deaths in 69 cases or 11.6 per cent. Unfortunately the late results are not given.

Guleke reports one case after two years in which a barium meal showed barium passing through the stoma into the gall-bladder, through the cystic and common ducts back to the duodenum, proving the subsidence of obstruction in the head of the pancreas.

2. The second method to be considered is some form of anastomosis between the common or hepatic duct and the upper gastrointestinal tract, either by suture or by means of a tube connecting the duct with the intestinal tract. Choledocho- or hepatico-enterostomy or duct reconstruction is to be employed where the gall-bladder is absent or where the obstruction is above the level of the cystic duct. The lesions requiring these desperate procedures are most frequently the duct stenoses, following cholecystectomy, the result of inadvertent injury to the duct by the surgeon or of a choledochitis. Not all of these injuries are the result of careless or unintelligent surgery. The anomalous arrangement of the cystic or hepatic ducts may simulate the normal anatomy and the common or hepatic duct may be injured or severed under the eye of the most skilled surgeon. I well remember such an occurrence in the clinic of one of the ablest surgeons of this country. In fact the common

duct was severed a few minutes after he had warned his medical students of the dangers of such an accident. He proved himself worthy of his reputation as a great surgeon by recognizing the injury immediately, acknowledging it frankly and openly, and promptly repairing it with faultless technic.

Unfortunately the majority of these stenoses are the result of unrecognized injury to the ducts by the relatively inexperienced surgeon. Failure to define the cystic duct as a definite structure joining the neck of the gall-bladder with the common duct, injudicious application of a curved clamp with the tips pointing toward the common hepatic duct instead of toward the gall-bladder, too great traction on the gall-bladder with coning of the common duct and insufficient cystic duct stump, the hasty and blind application of a hæmostat to catch a spurting cystic artery in the gastro-hepatic omentum, injudicious application of the cautery to the cystic duct, failure to recognize an anomalous arrangement of the duct system, these are the inadvertant but not always excusable causes of subsequent stenosis.

There has been considerable discussion in regard to the dilatation of the cystic duct stump and recently Sweet has maintained that gall-stones are formed in the cystic duct. Notwithstanding the blame placed upon the cystic duct, it seems to the writer far more dangerous to attempt to remove all of the cystic duct because of the subsequent stricture and damage to the common duct that might ensue, than to leave a portion of the cystic duct as has been done in the past in the old cholecystectomy. The stump of the cystic duct, half a centimetre in length is far safer than an attempt to remove all of the duct.

If the injury is recognized and immediately repaired the end-to-end anastomosis is usually easy and stenosis seldom occurs. If after removing the gall-bladder, bile appears in the region of the gastro-hepatic omentum, injury to the common duct should always be suspected and should be ruled out before closing the abdomen. The cystic duct stump of the gall-bladder should be inspected to make sure it has the normal arrangement. I believe that if any anomalous vessel or duct is noted it is essential to remove the gall-bladder from the fundus down to the duct in order to avoid injury to abnormal ducts. I also believe that with the œdematous acute gall-bladders, with the accompanying œdema of the cystic duct and gastro-hepatic omentum, injury to the ducts is less liable to occur if the gall-bladder is removed from fundus to duct.

There are a certain number of acute cholecystitis cases associated with cholelithiasis. If in the removal of these gall-bladders the gastro-hepatic omentum is dissected or unduly traumatized, stenosis of the common duct is more liable to occur as a late complication or even a sequel. I look upon these cases as among the relatively few requiring cholecystostomy. Certainly drainage tubes along side and in contact with the cystic duct stump are to be avoided. Tube pressure on the gastro-hepatic omentum favors subsequent stenosis.

The appearance of jaundice within 48 hours after a cholecystectomy, with or without a later establishment of a biliary fistula is the unwelcome but warning sign of common or hepatic duct injury. Especially is this true

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if at time of operation there was no evidence of common duct stone, and very evidently if no stones were present or only a single cholesterol stone was removed with the gall-bladder. In these cases if the patient's condition permits, not more than ten days should elapse before exploring the patient for the cause and repair of the fistula.

It is the procrastination of the surgeon and patient that brings these cases to other surgeons after periods of weeks and months for the late repair of the duct injury. Too frequently they come after one or more attempts at repair have been unsuccessful. It is self-evident that the longer the duration of the jaundice and if more than one attempt has been made to repair the duct, the greater the danger to the patient, the more difficult the operation and the less chance of a permanently successful result. These patients have a prolonged clotting time that responds poorly to the usual measures, but calcium in the form of chloride or lactate given intravenously is essential as a pre- and post-operative measure. In 1918, the writer reported the successful use of calcium lactate intravenously and we have since used it with excellent results. We give it intravenously in a 0.2-0.5 per cent. solution in 5-10 per cent. glucose up to .6 gram amounts 12 and 6 hours before operation. Because of the narrow margin of liver and kidney efficiency glucose and fluids by clysis are essential as a pre-operative measure. Blood transfusion is necessary in some of these patients both before and after operation. Digitalis, given as the tincture in 8-10 c.c. in saline by rectum the night before has steadied the heart action in our cases and helped to tide over a stormy post-operative course in two cases with myocardial damage.

If a biliary fistula is not present some form of anastomosis between the common or hepatic duct and the duodenum is the method of choice. I am sure that if a suture anastomosis can be made between distended duct and duodenum without the insertion of a tube, the result will be more permanently satisfactory. If a tube has to be used where only a partial suture repair is feasible it should not be sutured into the line of anastomosis if the tube projects for any distance into the duodenum. In one of my cases, in which I was able to do a satisfactory suture anastomosis between duodenum and junction of right and left hepatic duct the peristalsis of duodenum pulled on the tube that had been sutured into the line of anastomosis and tore the anastomosis on the third day after operation.

The attempts to reconstruct a passage between hepaticus and duodenum by means of a rubber tube covered with omentum are seldom permanently satisfactory. A few cases have been reported free from jaundice for periods of over a year, but they are exceedingly rare and the failures are not reported. The fundamental difficulty in these attempts to bridge the gap between duct and intestine with a peritonealized tube is that the irritating contaminated bile causes a round cell infiltration of the wall of the tube with subsequent connective tissue replacement and scar tissue contracture. Horsley has discussed this principle in detail based upon his animal experiments in everted veins as a means of bridging bile duct defects. The same principle

holds true in the fascial and aponeurotic tube implants. Walton's suggestion of constructing a tube made from a flap of duodenal wall to bridge the gap between hepaticus and duodenum is a possible method, and he reports one successful case followed for four months. The danger of a duodenal fistula is a drawback to this method.

If the patient presents a long-standing biliary fistula, and especially if a previous attempt or attempts to reestablish a bile passage have been made the possibility of implanting the external opening of the fistula into the stomach or duodenum must be considered. It has been successfully done in a number of instances as evidenced by Doctor St. John's patient this evening. Lilienthal and Lahey have reported good results. Lahey refers to a case of Hugh Williams, alive and well nine years after operation. There are several very essential factors in the success of this operation. It should not be attempted until the fistulous tract is well established and well vascularized. The dissection of the tract should leave a cylinder of tissue at least a centimetre in diameter surrounding the fistula. Under no circumstances should the tract be opened, nor should the dissection be carried beyond the margin of the liver. For this reason it is more feasible to implant the short cylinder of tissue containing the fistula into the stomach. The stomach offers a firmer structure into which the cylinder can be anchored. A diamond-shaped zone of skin surrounding the external opening of the fistula and forming the end of the cylinder to be implanted facilitates the accurate and firm anchoring of the fistula into the stomach wall.

In our series three attempts have been made, Doctor St. John's being the only successful case. In one of my cases the patient had a beginning cholemia and died in coma twenty-four hours after operation. In the third case the tract was impaired in the dissection and a gastric fistula resulted with peritonitis. The other long standing cases reported are those of Hugh Williams, now free from symptoms fourteen years after the operation, the case of Lilienthal, operated upon December 18, 1921 and is now free from symptoms and finally the patients of Lahey. A personal communication from Lahey states "This biliary fistula was operated upon October 19, 1922, and his fistulous tract was transplanted into his duodenum on this date. He has remained entirely well, has not been jaundiced, has gained eighty-five pounds in weight, is free from digestive symptoms, his stools have constantly been well colored and he is, I believe, pretty nearly a one hundred per cent. result. The second case was operated upon December 28, 1923. Her fistulous tract was transplanted in pylorus portion of stomach. She is now well. Soon after the operation she had attacks of jaundice with chills, but now for the last three years has been entirely free from symptoms with her stools well colored, no jaundice."

Eliot in his review collected 15 cases of hepato-enterostomy, that is where the duodenum or jejunum was sutured to an incision or cautery puncture of the liver. Ten patients died after this operation, one case lived three years, but the validity of drainage by this method is open to question.

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It is with the desire to stimulate the publication of all the cases in an individual clinic that the following report is made. It is not until the failures as well as the successes of several clinics are published that the hazards and difficulties of such procedures will be realized in proportion to the successes.

Side-Tracking Operations at Presbyterian Hospital in Twelve Year Period

Total number	35	
Cases with Carcinoma	21	
<i>Carcinoma of the Pancreas</i>	16	
Cholecystoduodenostomy	8	1 patient lived 25 months.
Cholecystogastrostomy	6	1 patient lived 7 months.
<i>Carcinoma of Common Duct</i>	4	
Cholecystoduodenostomy	3	1 patient lived 36 months.
Choledochoduodenostomy	1	1 patient lived 24 months.
<i>Carcinoma of Gall-bladder</i>	1	
Transduodenal Choledochostomy	1	
Benign Lesions	14	
<i>Chronic Pancreatitis</i>	6	
Cholecystoduodenostomy	4	1 patient lived 19 months.
		1 alive 5 months.
Cholecystogastrostomy	2	1 living 12 months.
		1 last heard from 27 months post-operative.
<i>Stenosis of Common Duct</i>	6	
Choledochoduodenostomy	3	1 lived 25 months.
Implantation of fistulous tract into stomach	3	1 living and well, 36 months.
<i>Atypical Cirrhosis</i>	1	
Cholecystogastrostomy	1	
<i>Cyst of Hepatic Duct</i>	1	
Choledochoduodenostomy	1	

Of the 21 Carcinoma cases—None are now living.

Of the 14 Benign cases—4 are living and well.

CASE REPORTS

CASE I.—G. M., age thirty-one, male. Patient admitted to P. H., April 5, 1924, with history of loss of appetite and strength for two years. He became jaundiced and had clay-colored stools. Following an osteopathic treatment during which he was pummelled in the region of the liver he had a severe sharp pain in the right upper quadrant, going to the back. He vomited two or three times. In bed a week.

One month before admission he began to have recurrence of pain in the right upper quadrant associated with light-colored stools. No nausea or vomiting. Two days before admission he had a severe attack of pain in the right upper quadrant radiating to back.

On admission he was slightly jaundiced, uncomfortable with pain and there was considerable spasm in the epigastrium and the right upper quadrant. Temperature 99. Pulse relatively normal. Respiration 24. White blood cells 13,500. Polymorphonuclears 76 per cent. Trace of bile in the urine.

Diagnosis.—"Acute cholecystitis."

Operation.—Cholecystectomy.

Gall-bladder markedly distended, œdematous with fibrin on its surface. It was aspirated and removed. No stones felt in bladder or ducts. Cigarette drain to Morrison's pouch.

Pathological Report.—Gall-bladder with wall 6-7 mm. thick. No calculi. Mucosa destroyed, its place being taken by fibrin. Extensive blood extravasation in the submucosa with some cedema and leucocytic infiltration. Submucosa enormously thickened by cedema and fibroblast infiltration.

Course complicated by post-operative pneumonia. Third day post-operative, up to which time patient had been jaundiced, the dressing was soaked with bile. After this the biliary fistula persisted and the stool was repeatedly negative for bile, until the patient was given his own bile by mouth which he took for a period of five weeks.

Eighty-six days post-operative a second operation was performed by Doctor St. John at which the great omentum and transverse colon, liver, duodenum and stomach were found to be adherent. Distal portion of the biliary sinus was dissected, including the surrounding skin for about 1 cm. in all directions, and implanted into the prepyloric segment. Wound closed without drainage.

Post-operative Course uncomplicated. Patient discharged twenty-six days post-operative, bile having been present consistently in the stool after operation, and there having been no jaundice.

One year post-operative patient is symptom-free. Has gained sixty pounds.

Twenty-one months after second operation, patient is symptom-free, appetite excellent. Has not lost a day's work in sixteen months.

CASE II.—E. H., age fifty-four, male. *Chief Complaint.*—Jaundice, pruritus, diarrhœa. Patient was admitted to the Medical Ward with four weeks' history of deepening jaundice, diarrhœa, loss of weight. During this time he had had no pain. Diarrhœa had varied from six to sixteen stools a day, he had lost fourteen pounds in ten days.

Past.—He had had no previous similar trouble. Typhoid at 20. No history of biliary colic or digestive disturbances. Occasional alcoholic excesses.

Physical Examination.—Patient was thin, jaundiced. Blood pressure 85/45. Liver edge flat, firm, not tender, 9 cm. below xiphoid. No masses felt. Wassermann negative.

Diagnosis.—Chronic pancreatitis. Cholecystogastrostomy.

Operation.—Cholecystogastrostomy. Anaesthesia local. .5 novocaine.

Findings.—The findings were remarkable. (1) Liver was enlarged to level of the umbilicus and had the appearance of a biliary cirrhosis.

(2) The gall-bladder was greatly distended, filled with a "white" thin bile which continued to pour out into the gall-bladder when aspirating cannula was inserted, from the hepatic ducts, i.e., cystic duct was patent.

(3) No stones were found in either gall-bladder or common duct.

(4) The pancreas was hard, irregularly indurated, nodular, both in head and body.

(5) The duodenum was anomalous in that it lay retroperitoneal and to the median side of pars pylorica so that sufficient exposure, even of the first and second positions could not be obtained or exposed for a cholecystoduodenostomy.

(6) There was a very marked hypermotility of the stomach, especially pars pylorica—patient was under local anaesthesia throughout.

Procedure.—Arch and incisional anaesthesia with .5 per cent. novocaine giving excellent anaesthesia and good exposure. On noting the above findings diagnosis of carcinoma of the pancreas was made. A section from the pancreas was removed for diagnosis. Trochar and cannula inserted in median aspect for gall-bladder white bile aspirated. Because of duodenal anomaly a cholecystogastrostomy was decided upon, and was done with chromic, side of gall-bladder to side of pars pylorica, sero-serous suture followed by over and over running suture of all coats of the two stomata. Opening .5 cm. resulted from the anastomosis which was entirely satisfactory when completed. Closure: Peritoneum and post-rectus sheath continuous intersilk. Anterior rectus sheath, continuous intersilk. Subcutaneous tissue and skin, four silk sutures on small buttons. Skin, continuous dermal. No drain to peritoneum. Short goitre tube to subcutaneous tissue.

SIDE-TRACKING BILE DUCT OBSTRUCTION

Pathological Report.—Pancreas—Chronic pancreatitis. Cultures of gall-bladder and bile—Staphylococcus Albus.

First day post-operative—blood pressure 116/60.

Second day post-operative—stool for bile negative.

Third day post-operative—stool for bile++.

Fourth day post-operative—stool for bile++++.

Seventh day post-operative—jaundice decreasing, appetite returning, diarrhoea cleared.

Discharged seventeenth day.

Follow up fourteen months after operation, no recurrence of jaundice or of any other symptoms.

CASE III.—M. S., age fifty-four, male. *Chief Complaint.*—Persistent jaundice. For several years has had what he calls "dyspepsia"—epigastric distress, at times increasing to a severe pain radiating to the back. With these attacks he would have nausea and distaste for food. Aside from this there is no definite history of any typical gastric or biliary syndrome. No previous history of jaundice. Habits temperate.

Three weeks before admission he had an unusually severe attack of epigastric pain, going through into his back, with nausea and anorexia. Soon after this he began to develop jaundice which has continued increasing, although stools have varied in color. For the last two weeks before admission he had chilly sensations and real chills, with variable rises in temperature. He was examined two weeks before admission, when he showed light jaundice, tenderness in epigastrium, no palpable mass or gall-bladder in the right upper quadrant. The liver was enlarged. The differential diagnosis was thought to be between common duct stone and carcinoma of the pancreas. Because of deepening jaundice and recurring chills operation was advised and accepted.

On admission, he was deeply jaundiced. Liver enlarged 5 cm. below costal margin, no palpable mass suggesting gall-bladder. Tenderness vague in upper abdomen.

Operation.—Cholecystoduodenostomy for common duct obstruction due to pancreatitis.

Findings.—Contrary to expectation no stones were found in the common duct or in the gall-bladder. The gall-bladder was markedly dilated. The liver was somewhat enlarged, overlapping the enlarged gall-bladder. The seat of the obstruction was found to be in the head of the pancreas where hard nodular mass was discovered, apparently closing the common duct. This in the gross appeared to be carcinoma. A section was taken from the hardest part of the mass, fairly good sized, making it possible to provide ample material for pathological examination. The absence of stones in the gall-bladder was a corroboratory evidence of the absence of stone finding in the common duct. Because of the lesion in the pancreas and the dilation of the gall-bladder, short circuiting operation was decided upon and the fundus of the gall-bladder was sutured to the outer side of the second portion of the duodenum as follows:

Procedure.—An opening a centimetre long was cut in both the gall-bladder and the duodenum after the serous surfaces of the two viscera had been sutured in a semi-circle. The cut edges of the two stoma were then united by means of a through and through suture of all the guts. The sero-serous suture was then resumed to the point of beginning. The abdomen was then closed as follows without drainage: Peritoneum and posterior rectus sheath, continuous chromic interrupted twice, anterior rectus sheath, continuous chromic, subcutaneous tissue and skin and anterior rectus sheath, silk on pearl buttons. Skin, continuous dermal.

Post-operative Course.—For several days he was asthenic. Blood urea rose to 1.23 gms./L. He had anorexia and vomiting, jaundice cleared slowly. Blood-pressure dropped from 120/80 on second day to 98/60 on twelfth. Discharge twenty-second day. Weight 128 pounds.

One month follow-up: Jaundice cleared. Feeling well except for some distress if he eats too much or certain foods such as fats and rich food.

ALLEN O. WHIPPLE

Four months' follow-up: Has had no recurrence of jaundice. Has gained eighteen pounds in weight. Is feeling well except for some distress after eating fats or highly seasoned foods.

Seven months' follow-up: One month after last follow-up patient developed signs of pyloric stenosis, not relieved by lavage, and requiring a gastro-enterostomy for a stenosis of the duodenum, caused by the angulation as a result of contraction of the gall-bladder. Examination of the pancreas at this time revealed a hard mass at the head of the pancreas, section from which proved to be a carcinoma. The patient at the last report was losing ground in weight and strength, although he had had no recurrence of jaundice or of gastric obstruction.

METASTATIC CARCINOMA IN THE URETER*

REPORT OF ADDITIONAL CASES

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PRIMARY tumors in the pelvic viscera frequently metastasize into the lymph-nodes along the iliac vessels and abdominal aorta, in a large number of cases metastatic nodules are found in the bones, lungs or liver as described by Langstaff,¹ Tanchau,² Gross,³ Adams,⁴ Thompson,⁵ Von Recklinghausen,⁶ Cone,⁷ Blumer,⁸ Bumpus,⁹ Kaufmann,¹⁰ Young,¹¹ and others.

Since the lymphatics of the ureters communicate with those of the bladder, it is surprising that so few reports on metastatic carcinoma in the ureter and kidney pelvis are to be found in the literature.

Garceau,¹² in 1909, was able to collect from the literature 13 cases of metastatic carcinoma in the ureter due to extension by continuity.

Giordano and Bumpus,¹³ in 1922, reported a case of carcinoma of the prostate metastasizing to the left ureter and renal pelvis, which showed no evidence of invasion of the lymphatics in the ureter, and were able to demonstrate cancer cells in the blood-vessels of the lungs and in a metastatic renal infarct.

Thomas and Regnier,¹⁴ in 1924, reported a case of carcinoma of the bladder with metastases to lymph-glands, liver, psoas muscle and right ureter, without indicating how it was transmitted.



FIG. 1.—Case I. Carcinoma of the prostate with metastasis to right ureter; ureteral dilatation, bilateral; ureteritis, bilateral.

* Read before the Wisconsin Urological Society, March 19, 1927.

Cullen¹⁵ has shown cancer of the cervix ulcerating through the lower end of the ureter, but makes no mention of metastatic nodules in the ureteral wall, the result of lymphatic metastasis.

Ewing¹⁶ describes papillary tumors of the bladder extending into the lumen of the ureter or invading from the vesical wall, and primary tumors of the kidney pelvis extending down the ureter. In prostatic cancer Ewing states that the ureters are invaded from the vesical wall as in bladder

carcinoma, or occluded by nodules at the orifice, or compressed by enlarged lymph-nodes.

Herger and Schreiner,¹⁷ more recently in an analysis of thirty-two autopsies on patients dying from carcinoma of the cervix, found twenty-one cases showing gross pathological changes in the urinary apparatus—viz.: stricture of left ureter with accompanying hydronephrosis, 4; stricture of right ureter with accompanying hydronephrosis, 3; ureteral stricture, bilateral with accompanying hydronephrosis, 10; pyonephrosis, 1; caseous kidney, 1; infiltration into bladder, with no hydronephrosis, 2; 16 of the cases showing hydronephrosis were accompanied by marked infiltration into the bladder. They concluded that the ureteral strictures are the result

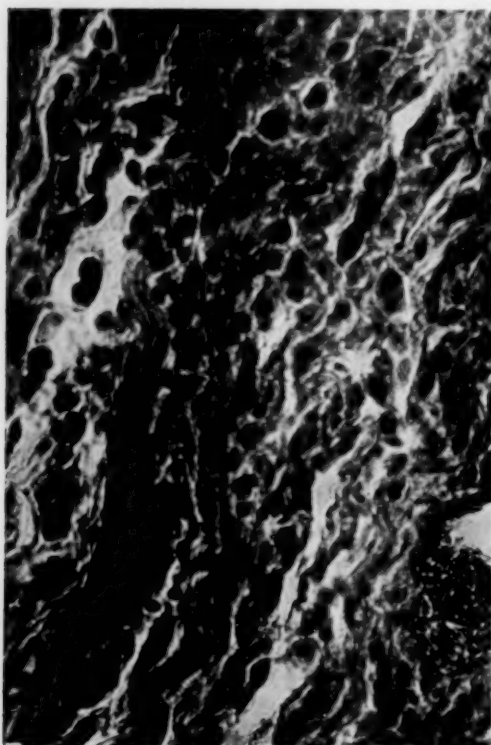


FIG. 2.—Case I. Photomicrograph of right ureter, 20 cm. above bladder, showing tumor cells in peri-vascular lymphatic.

of pressure on the ureter from invasion of the broad ligament or bladder wall, which possibly may be made worse as a result of fibrosis in the healing of these lesions, but make no mention of metastases into the ureter.

Young¹⁸ states that metastasis to the wall of the ureter may occur, usually the lower third, causing obstruction with hydro-ureter and hydronephrosis. The route in such cases may be lymphatic and records having seen two cases of ureteral metastases from prostatic carcinoma.

Bumpus¹⁹ in a clinical study of one thousand cases of carcinoma of the prostate found 243 cases with demonstrable metastases. In 44 per cent. it had affected the lymphatics.

Since the writer²⁰ first demonstrated cancer cells in the perivascular lymphatics of the ureter, secondary to primary carcinoma of the bladder, prostate and cervix uteri two additional cases have been found at autopsy.

METASTATIC CARCINOMA IN THE URETER

CASE REPORTS

CASE I.—J. S., white, male, age seventy-three years. Admitted to University Hospital, December 30, 1924, with acute retention of urine and died June 22, 1925.

Clinical Diagnosis.—Carcinoma of the prostate with metastases to the third, fourth, and fifth lumbar vertebra; uræmic coma. Terminal lobular pneumonia. Genito-urinary organs. (Fig. 1.)

Prostate.—The prostate is very firm and nodular on section, there are numerous irregular areas of a grayish-yellow color. In the lower portion of the tumor mass there is a cavity formation, the wall of which is of a grayish-black color, having the appearance of a radium burn. The outline between the prostate and seminal vesicles is very indistinct due to direct extension of the tumor. Lymph-nodes along the internal and common iliac arteries and abdominal aorta show metastatic deposits.

Bladder.—The bladder wall varies from 3 to 6 mm. in thickness, mucosa is of a dark red color, covered with yellowish exudate in areas. Ureteral orifices are moderately dilated 3 mm.

Ureters.—The ureters are dilated from the bladder wall to the uretero-pelvic junction varying in diameter from 10 to 20 mm., with the greatest diameter above the pelvic brim. On section their walls measure 2 mm. in thickness with the mucosa varying from bright red to dark red in color, in areas a yellowish exudate is seen on the surface of the mucosa.

Kidneys.—The pelves, major and minor calyces are moderately dilated with their mucosa of a dark red color.

The capsules strip off with resistance, leaving an irregular dark reddish surface with a few small round yellowish areas which contain a purulent exudate.

The architecture is poorly preserved.

Anatomical Diagnosis.—Adenocarcinoma of the prostate with metastases to the lymph-nodes along the iliac arteries and abdominal aorta; lumbar vertebra; seminal vesicles; bladder wall; right ureter; dilatation of ureter, bilateral; hydronephrosis, bilateral; cystitis; ureteritis, bilateral; pyelitis, bilateral; pyonephrosis, bilateral; duodenal ulcers, etc.

Microscopical Notes.—*Prostate:* Sections from each lobe show the muscle fibres and connective-tissue fibres to be well stained. The glandular acini show their lining epithelial cells to be very well stained, most of which have hyperchromatic nuclei, a moderate number show mitotic cell division. These cells are seen breaking away from their basement membrane and infiltrating through the stroma. There is a definite reduplication of prostatic glandular acini arranged in a disorderly fashion. The blood-vessels show thickening of the tunica intima.

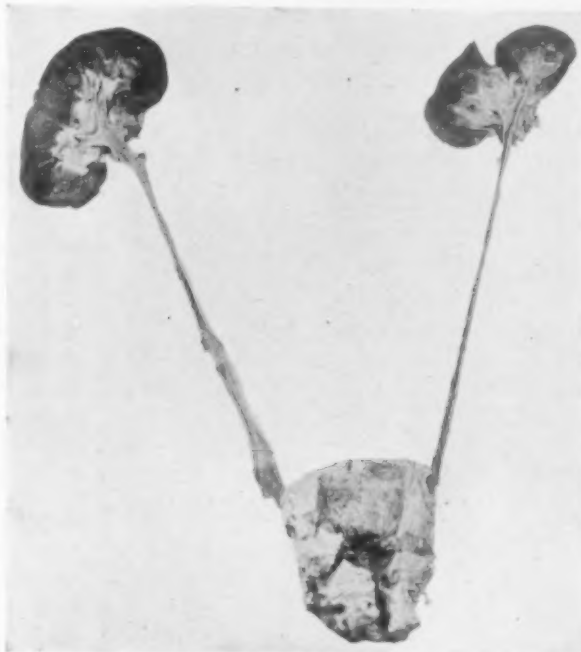


FIG. 3.—Case II. Carcinoma of prostate with metastases to the bladder, seminal vesicles, right ureter, right kidney pelvis, cystitis.

Seminal Vesicles.—Sections show a definite infiltration of epithelial cells which have a hyperchromatic nuclei and a clear cytoplasm, a few showing mitotic cell division. In areas they are arranged as glandular acini giving the same appearance as those seen in the prostate.

Bladder.—Sections from base and lateral walls show an infiltration through the muscular layer and submucosa of epithelial cells, columnar or cuboidal in shape in areas, a large number are undifferentiated in appearance, with hyperchromatic nuclei and a clear cytoplasm, mitotic cell division is visible in areas. These cells are seen breaking away from their basement membrane in various areas.

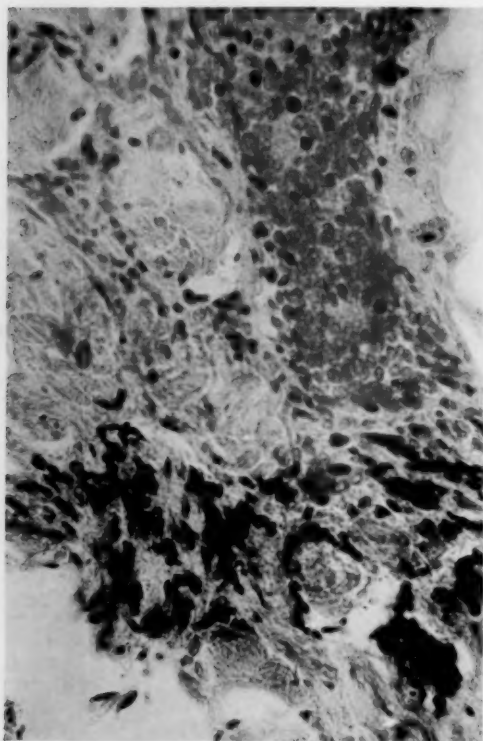


FIG. 4.—Case II. Photomicrograph right ureter 15 cm. below uretero-pelvic junction, showing tumor cells in lymphatics.

Ureters.—Right (Fig. 2). (Section from 10 cm. up and 20 cm. up.) The serous surface shows the serosa to be fairly well stained. Immediately beneath the serous cells is seen a moderate infiltration of mononuclear wandering cells and large round cells, an occasional plasma cell is noted. In the inner two-thirds of the muscular layer an infiltration of epithelial cells undifferentiated in type with hyperchromatic nuclei and a clear cytoplasm. A few show mitotic cell division. In areas they are arranged as small glandular acini. The tumor cells are visible in the perivascular lymphatics. The tunica propria shows a moderate infiltration of mononuclear wandering cells with an occasional polymorphonuclear leucocyte. Mucosa is absent for the most part, in one area the transitional epithelial cells are seen well preserved.

Left.—In the muscular layer there is a definite infiltration of mononuclear wandering cells and small round cells with a few polymorphonuclear leucocytes, they are more abundant in inner half of the muscular layer and tunica propria. Mucosa shows the transitional epithelial cells poorly stained with fibrin and poorly stained leucocytes within the lumen. Blood-vessels are filled with red blood-cells with the perivascular lymphatics visible.

CASE II.—R. McN., white, male, age seventy-five years. Admitted to University Hospital, September 25, 1925, with acute retention of urine and died September 30, 1925.

Clinical Diagnosis.—Carcinoma of the prostate; myocardial hypertrophy and insufficiency; paralysis agitans, etc. Genito-urinary organs. (Fig. 3.)

Prostate.—The prostate is enlarged, firm and nodular, on section numerous irregular yellowish-gray nodules are seen. From this tumor mass in the prostate, metastasis can be seen by continuity, infiltrating into the base of the bladder, seminal vesicles and lymph-nodes.

Bladder.—The bladder wall is markedly thickened, measuring from 8 to 14 mm. in thickness. In the muscular wall at the base, there are irregular yellowish-gray lines. Mucosa is dark red in color, ureteral orifices gaping 3 mm. in diameter

Seminal Vesicles.—Are enlarged, firm and nodular, on section numerous irregular

METASTATIC CARCINOMA IN THE URETER

yellowish-gray nodules are seen. There is no definite line of separation between the bladder and seminal vesicles.

Ureters.—*Right:* There is a moderate dilatation of the lower 15 cm. varying from 8 to 10 mm. in diameter. On section the wall measures 2 mm. in thickness with the mucosa of a dark red color. On palpation several small nodules can be felt 6 cm. below the ureteropelvic junction.

Left.—The diameter varies from 2 to 7 mm. On section the wall measures 1 to 2 mm. in thickness with the mucosa showing several areas of a dark red color.

Kidneys.—Right kidney, 10.5 by 6 by 3 cm. Left kidney, 10 by 5.4 by 4 cm.

The capsules strip off with marked resistance, leaving a finely granular reddish surface. On section the kidneys are seen to be contracted, with the architecture poorly preserved. The blood-vessels stand out prominently in the cortical portion. The mucosa of the pelves and calyces is dark red in color.

Anatomical Diagnosis.—Carcinoma of the prostate with metastases to the bladder, seminal vesicles, right ureter, right kidney pelvis, lymph-nodes along the internal iliac arteries, abdominal and thoracic aorta, and lungs; cystitis; hypertrophy of bladder wall; chronic diffuse nephritis, arteriosclerotic type, etc.

Microscopical Notes.—*Prostate:* Sections from each lobe show the muscle fibres and the connective-tissue cells to be poorly stained. There is a marked glandular hyperplasia. There are many new-formed glandular acini lined by epithelial cells which are for the most part undifferentiated in type, with clear cytoplasm and hyperchromatic nuclei. A large number of these cells are seen breaking away from their basement membrane, and infiltrating in a disorderly fashion between the connective-tissue cells and the muscle fibres.

Bladder.—Section taken from the trigon shows a definite infiltration through the muscular layer of epithelial cells embryonic in type, mitotic cell division being visible. In the submucosa a moderate number of mononuclear wandering cells and polymorphonuclear leucocytes are seen. The mucosa is poorly stained throughout. Blood-vessels show a marked thickening of the tunica intima.

Seminal Vesicles.—Sections show the same type of tumor cells arranged as glandular acini.

Ureter.—*Right.*—(Fig. 5.) Six cm. below uretero-pelvic junction. The outer half of the muscular layer shows a definite infiltration of epithelial cells of an undifferentiated type with clear cytoplasm and hyperchromatic nuclei. A few of these cells are undergoing mitotic cell division. The perivascular lymphatics show their sinuses filled with tumor cells. In several areas the perivascular lymphatics are replaced by epithelial cells arranged as glandular acini. The tunica propria is poorly stained, with a moderate number of small round cells, mononuclear wandering cells, and polymorphonuclear leucocytes beneath the mucosa. Mucosa—shows the transitional epithelial cells intact on their basement membrane, a few of which are poorly stained.

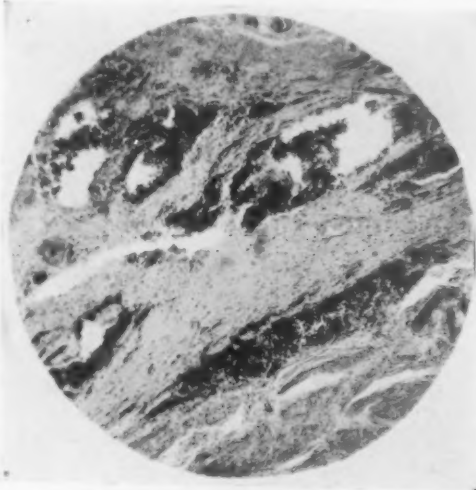


FIG. 5.—Case II. Photomicrograph right ureter, 6 cm. below uretero-pelvic junction, peri-vascular lymphatics are replaced by epithelial cells arranged as glandular acini.

Kidney Pelvis.—Right.—(Fig. 6.) The muscular layer shows the muscle fibres to be poorly stained. There is a marked increase of fibrous connective tissue separating the muscle fibres. The blood-vessels show a perivascular infiltration of epithelial cells with clear cytoplasm and a hyperchromatic nuclei, a few of which show mitotic cell division. The tunica propria shows a moderate infiltration of small round cells and mononuclear wandering cells. Mucosa shows the epithelial cells well preserved and intact on their basement membrane.

Discussion.—"The lymphatics of the ureter are more numerous in the

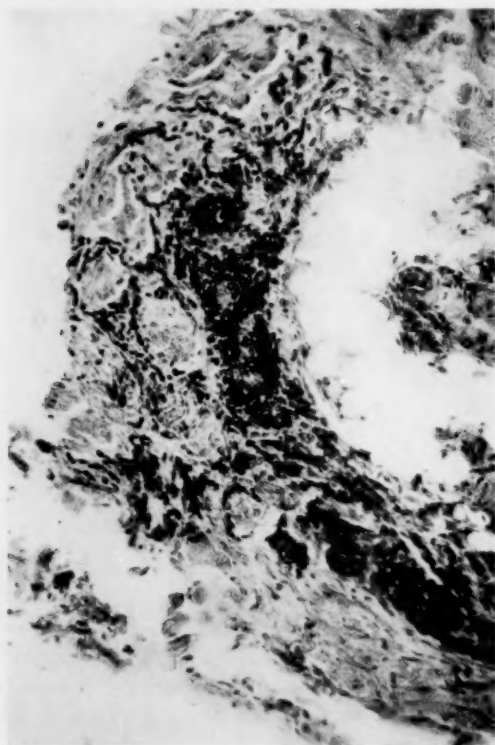


FIG. 6.—Case II. Photomicrograph right kidney pelvis, showing tumor cells in the peri-vascular lymphatics.

muscular coats and adventitia than in the mucosa and sub-mucosa. They accompany the arteries and drain in three directions, the lower portion downward in the direction of the bladder, the pelvic and abdominal portion mesially into the pelvic and lumbar lymph-glands, the upper portion in the direction of the renal lymphatics." Kelly and Burnam.²¹

In 1923, Arthur Robinson²² states that little is known of the lymph-vessels of the ureter except that those of its lower extremity anastomose with the bladder and suggests that the vessels pass to the nearest lymph-glands.

While the lymphatic system is, without doubt, the earliest and most frequent site of metastatic lesions in carcinoma of the

prostate,¹⁹ it would seem that the drainage of the lymph downward, in the lower portion, is the explanation for the rarity of metastases to the ureters from prostate or other pelvic viscera.

Giordano and Bumpus¹³ were the first to demonstrate carcinoma of the prostate metastasizing to the renal pelvis and are of the opinion that it is carried through the blood stream.

In Case II previously reported²⁰ and Case II of this report the cancer cells were carried through the lymphatics to the renal pelvis.

Heger and Schreiner,¹⁷ in 1926, report strictured ureters, hydro-nephrosis and pyonephrosis occurring in cancer of the cervix, without a microscopical description. These were probably inflammatory in origin as described by Carson in 1925.²⁰

METASTATIC CARCINOMA IN THE URETER

CONCLUSIONS

(1) Two cases of primary carcinoma of the prostate extending to the ureters by lymphatics are reported.

(2) A third case of carcinoma of the prostate metastasized to the renal pelvis is reported.

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ENLARGEMENT OF THE PROSTATE GLAND WITH CHARACTERISTICS RESEMBLING HODGKINS' DISEASE*

MALIGNANT GRANULOMA

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THIS report concerns a case of complete retention of urine due to a gradually increasing enlargement of the prostate gland in a young man aged thirty-two years.

The case presents a number of unusual features. Complete retention of urine due to enlargement of the prostate gland is very rare indeed in a man of this age, excepting when the increase in size is due to some acute infection of the gland usually associated with abscess formation.

A search of the literature has failed to reveal any reference to a condition simulating that found in this case. While a neoplasm might have been suspected we have not seen a description of any tumor of the prostate at this particular age. Sarcoma of the prostate usually occurs much earlier and carcinoma and benign enlargements occur later in life.

While we have reviewed the literature of malignant granuloma, it will suffice to state here that the Hodgkin's granuloma so-called, shows when fully developed a highly characteristic histological picture which enables one to make a more or less positive diagnosis. In many instances, however, this picture is not fully developed and the histological diagnosis then becomes increasingly less certain, and it may be added that the lesions of the prostate which we propose to consider in this paper belongs to this latter group as is evidenced by the report rendered on the case by the pathologist. While there is therefore some uncertainty concerning the nature of the lesions found, the case seems worthy of record because it presents certain features simulating Hodgkin's disease.

The blood picture in Hodgkin's disease as stated by F. C. Wood¹ does not yield as much information as the clinical features of the disease. Frequently we get a moderate anemia of the chloritic type, that is, with a relatively high number of red cells and a low hæmoglobin index. Poikilocytosis and degenerative changes in the red cells are not marked. The leucocytes are generally assumed to show no quantitative or qualitative changes, but it has been claimed by Pinkus² that all cases of pseudoleukemia have a distinct relative lymphocytosis which enables this disease to be easily distin-

* Read before the New York Branch of the American Urological Association, March 23, 1927.

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guished from other conditions resembling Hodgkin's disease, especially from those cases from which tubercle bacilli have been found in the lymph-node of patients otherwise running a course perfectly typical of true Hodgkin's disease.

Wood¹ and Da Costa³ state that a few cases show a relative lymphocytosis but these are in the minority. Ewing,⁴ on the other hand, thinks that a relative or absolute lymphocytosis usually prevails.

Bunting⁵ declares that an eosinophilia is so frequent and marked as to form an important diagnostic sign. Sabrazes Hippel⁶ states that evidences of hemorrhagic tendency are frequently observed as minute hemorrhages in the skin, petechiæ or purpura hemorrhagica.

Ralleston,⁷ Brammell,⁸ believe that the disease occasionally exhibits prodromal symptoms such as itching or erythematous eruption of the skin which may precede other symptoms by months or years. This bears considerable relation to the subsequent cause of lymph-node lesions, and may result in the definite and progressive cutaneous lesions of Hodgkin's disease. Gastro-intestinal disturbances may also be observed.

Our case presented a definite lymphocytosis, a moderate anæmia of the chlorotic type, an enlargement of the chain of inguinal lymph-nodes on each side, a loss of weight and strength and an impaired appetite and the general appearance of a tuberculous individual all associated with enlargement of the prostate, acute retention and urinary symptoms of only three months' duration. The case upon which this report is based presented the following history:

A single man, age thirty-two years, was admitted to the Medical Division of Dr. Lewis B. Conner on December 7, 1926, and transferred to the Urological Division December 11, 1926. He stated that his father died at the age of fifty-nine, from cancer of the liver. He was ill fifteen months. His mother died at the age of twenty-eight, from pulmonary tuberculosis. She was ill one and a half years. He has one brother and two sisters, all living and well. He denies lues and gonorrhœa by name and symptoms. He had mumps ten years ago, pneumonia fourteen years ago. Until four years ago he was a chronic drinker. Since that time has not touched liquor. About three months before admission to the hospital he developed a moderate frequency of urination by day and by night. As time progressed this condition grew worse and was associated with

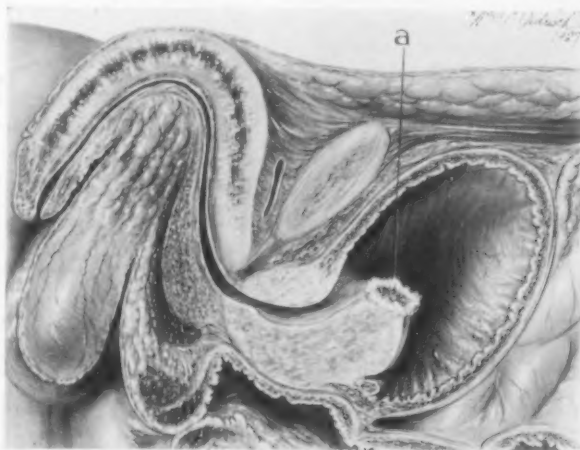


FIG. 1.—This picture is a sagittal view representing the enlargement of the prostate gland with marked intravesical intrusion. On its most prominent portion is represented the fungus-like appearance of that part whence a piece had been removed for diagnosis.

painful and difficult urination. He noticed no pus nor blood in his urine. His sexual powers were undisturbed. Three days before admission to the hospital he was unable to void except with utmost pain and difficulty. He finally developed acute retention and was brought to the hospital in an ambulance. His bladder was decompressed gradually by means of a retention catheter. He was fairly well nourished and seemed in moderately good health, although he stated that he had lost twenty pounds in weight during the past six months and during the past three months he had grown progressively weaker, but had not been confined to his bed. He had no cough. His bowels moved regularly. His appetite was somewhat impaired. He did not suffer from insomnia but grew dyspnoic on slight exertion.

His general physical examination was negative except for moderate bilateral enlargement of the inguinal lymph-node and a small fibroma on the inner aspect of the left thigh. His liver and spleen were not palpable. Chest negative. The lower poles of both kidneys could be felt as well as the distended bladder. Rectal examination revealed slight hemorrhoids. Sphincter tone was good. The prostate was about twice the usual size; it was hard on the right side but did not have the board-like rigidity of carcinoma. The left side of the prostate seemed normal in consistency and not fixed in position by adhesions. The left seminal vesicle was palpable but not enlarged. The right was barely palpable.

Cystoscopy under caudal anaesthesia revealed a diffusely reddened vesical fundus. Ureteral orifices were not distinctly seen. The vesical orifice was most interesting in that it showed a tremendous intrusion of the sub-cervical group on its floor.

Blood urea nitrogen was 17 mgs. per 100 c.c.; blood sugar 0.112 per cent.; carbon dioxid combining power of the blood plasma 56 volumes per cent. The phenolsulphone-phthalein test showed a secretion of 60 per cent. in two hours at one examination and 75 per cent. at another. Blood Wassermann was negative on two occasions. Cultures from bladder urine showed—*B. Coli Communis* and *Staphylococcus Albus*.

Urine examination, reaction acid, specific gravity 1018, there was a trace of albumen, no sugar, no acetone.

Microscopic examination showed many red blood-cells, few white blood-cells, occasional epithelial cells, no crystals, no casts.

Complete blood count was made on two occasions as follows:

	12/8/26	1/9/27
Red cells	5,112,000	4,815,000
Hæmoglobin	93%	88%
Color index	0.91	0.92
White cells	8,600	7,400
Polymorphonuclear neutrophiles	54%	48%
Lymphocytes	38%	44%
Large mononuclears	6%	7%
(Transitionals)		
Eosinophiles	2%	3%
Blood-pressure on entrance to hospital.	114 systolic	62 diastolic

X-rays of the genito-urinary tract revealed both kidney shadows large in size and low in position. There was no shadow indicative of stone in the urinary tract.

The patient was subjected to a supra-pubic cystotomy under local anaesthesia. Examination of the interior of the bladder revealed a mass extending from the floor of the bladder neck about the size of a walnut which was rather firm in consistency. A specimen was taken from this tumor-like projection and sent to the laboratory for examination. (Fig. 1.) The bladder was drained by supra-pubic suction for a period of fourteen days, after which time the prostate was removed suprapubically under sacral and para-

PROSTATIC GRANULOMA

sacral and regional anaesthesia. It was interesting to note that this growth had greatly increased in size since the first operation. The site whence the original specimen had been removed had grown out in a very irregular manner so that it resembled a cauliflower. Malignancy was suspected. The prostate was removed completely except for one point on the left lateral aspect where it was densely adherent and had apparently infiltrated into the capsule of the prostate. The patient made an uneventful recovery and was discharged from the hospital fourteen days after prostatectomy with good urinary control and wound completely healed.

The prostate was examined by the Laboratory Division of the New York Hospital. The report is as follows:

The specimen consisted of several irregularly shaped pieces of tough tissue measuring from 1 to about 4 cm. in diameter. The cut surface appears yellowish-white, somewhat translucent, with opaque yellowish strands running through a whitish matrix. The gross picture is not that of a carcinoma nor does it resemble normal prostatic tissue.

The microscopic examination shows the picture of a chronic inflammatory process. The granulomatous new-formed tissue is rich in plasma cells and contains mononuclear giant-cells suggestive of the Sternberg type, and also eosinophilic leucocytes. While these features are suggestive of Hodgkins lymphogranuloma, the evidence available is not sufficient to make a diagnosis of the disease.

An inguinal lymph-node was removed and examined. Microscopic sections showed simple chronic lymphadenitis with no evidence of a granulomatous process like that seen in Hodgkin's lymphogranulomatosis.

The small tumor on the inner aspect of the left side showed on microscopic sections the picture of a fibroma durum, covered by stratified squamous epithelium.

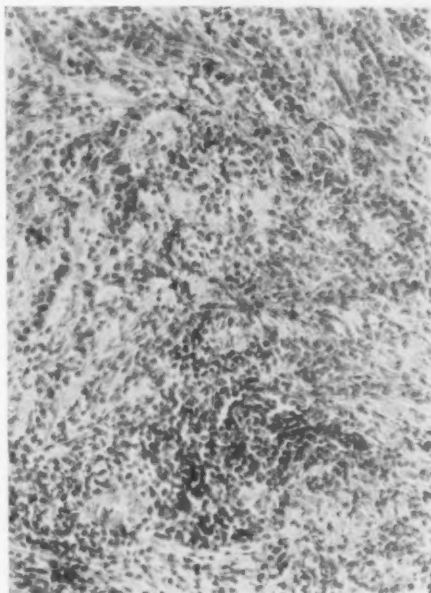


FIG. 2.—Photomicrograph of a section cut through the enlarged prostate gland. Microscopic examination of this section shows the picture of a chronic inflammatory process. The granulomatous new formed tissue is rich in plasma cells and contains mononuclear giant cells suggestive of the Sternberg type. There are also eosinophilic leucocytes.

SUMMARY OF FINDINGS

It is unusual to find a complete retention of urine in a man, age thirty-two years, due to a solid tumefaction of the prostate gland.

The gradual onset of the symptoms exhibited by the patient is similar to those described by most cases of adenomatous enlargements of the prostate in old men. The usual frequent and painful urination culminated in complete retention of urine rather more rapidly than most cases of adenoma.

There was a rapid increase in the size of the intrusion in the two-week interval between the spura-pubic cystotomy at which time a piece of tissue was removed from the tumor for diagnosis and the actual removal of the mass with the prostate. The spot whence the specimen was removed showed

a cauliflower overgrowth such as one sees in almost any malignant growth under similar conditions.

Upon removal it was noted that it enucleated quite freely except at one point on the left lateral aspect where it was densely adherent and apparently had infiltrated into the capsule of the prostate. The impression of the authors at the time of operation was that the case was one of malignant growth of the prostate.

The specimens removed when examined microscopically showed granulomatous new-formed tissue rich in plasma cells containing mononuclear giant-cells resembling the Sternberg type, and also eosinophilic leucocytes.

The examination of the enlarged inguinal lymph-nodes showed simple chronic lymphadenitis with no evidence of a granulomatous process like that seen in Hodgkin's lymphogranulomatosis.

CONCLUSION

In conclusion the case is described as one in which there occurred enlargement of the prostate gland having the histological picture resembling malignant granuloma or so-called Hodgkin's disease.

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SUSTAINED COUNTERWEIGHT-TRACTION IN HÆMOSTASIS OF PROSTATECTOMY

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THE very massive hemorrhage incident to the removal of the prostate from the very beginning of the performance of this operation has been controlled by the "quasi" pressure of tampons. The extensive tamponade of the bleeding bed with gauze long enjoyed a popularity. Its drawbacks were the large quantity of gauze employed necessitating a large fistulization of the bladder to effect its eventual removal, a procedure always fraught with pain and which large supra-pubic opening with gauze protruding obviated greatly the chances of an effective syphonage of urine and bladder contents.

With the introduction of the Hagner and Pilcher bags nearly all the aforesaid disadvantages were eliminated. These bags were made to contact with the bleeding surface by drawing taut the rubber tube at its exit from the urethra and maintaining this pull by anchorage to a cradle with its points of support on the pelvis. Now these cradles are difficult of adjustment and cumbersome in so far as they hamper the free movements of the patient and prevent a more intimate investment of the patient with the bed-clothes. To do away with these "cradles" or "anchors" it occurred to me to substitute a more sound mechanical principle, that of counterweight-traction playing over a pulley. The very nature of such traction sustained by counterweight precludes elastic traction; wherefore in the precise application of this principle, rubber bags with rubber tubes attached should be eliminated. The method of application thus follows. Upon completion of the enucleation a Nélaton catheter is introduced until its vesical end becomes visible or felt. To the vesical end drawn into the wound a length of enameled (water-proofed) linen fishing thread is secured. The catheter is withdrawn until a length of thread emerges requisite to pass over the foot of the bed and reach the floor—six foot is adequate for all occasions. To the thread emerging from the abdomino-vesical wound some Penrose tubing is secured by throwing a knot about loosely coiled folds of the tubing arranged in rosette fashion or with greater refinement transfixing loops of tubing with the same thread armed with a large needle. This accomplished, the thread coursing the urethra is pulled upon, causing the rubber tampon to follow until the resistance of the bleeding bed at the introitus of the bladder is met. Traction is then sustained by applying a sand bag of 3 to 5 pounds weight or a vessel with two litres of water (4.4 pounds) to the end of the thread which is allowed to fall over the end of the operating table. A stretch of thread emerges from the bladder wound. All other requirements in the repair of the wound may now be met and then the patient with the pendant

weight is transferred to the stretcher and in turn to bed. The line now passes between the lower extremities almost in contact with the plane of the bed and is guided over a pulley lashed to the foot of the bed with the weight of 3 to 5 pounds attached. It is readily apparent when this complete fixture is in place that the greatest comfort is assured to the patient. He may readily move about without dread or likelihood of displacing anything. The small size of the thread in the urethral canal is never as discomforting as the rubber tubes and if the weight appears to be exercising too great a pressure,

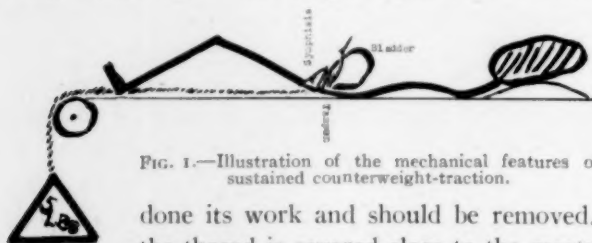


FIG. 1.—Illustration of the mechanical features of sustained counterweight-traction.

it may readily be lessened. At the end of 48 to 72 hours when the hæmostasis should be completed the rubber tubing (Penrose) has done its work and should be removed. The weight is detached, the thread is severed close to the meatus and the thread emerging from the bladder is drawn upon until the tubing appears in sight. By continued gentle traction by a slight torsion of the tubing this will be made to unfold itself and thus readily be removed rather painlessly through the comparatively small opening alongside of the rubber syphon tubing without interfering or displacing the same.

To summarize. Gauze tamponade pressure is illusory because the "point dappui" (prostate bed) can only be reached continuously if the bladder contracts about a large tampon occupying its interior. Air pressure being equal in all directions, much of the air under pressure in the bags is spent on the interior of the bladder remote from the wound. The methods of suture (Walker) to control hemorrhage by suture of the bleeding surface is ideal in its aim but inadvisable, because the exigencies inherent in most cases do not warrant the long time necessary for its performance.

By the principle of the sustained counterweight-traction pressure is transferred to the rubber tampon and solely centred upon the bleeding area immediately as if it were forcipressure; and the bladder wound is reduced to the minimum and its size being determined by the size of the drain for syphonage. Because of the perfect hæmostasis the size of the tubes need not be as large as those of Freyer or Marion since their large proportions aimed to facilitate the escape of large clots and the channel in which the tubes rested subsequently became the path along which the tamponade of gauze was removed.

Finally, it should be stressed that no special armamentarium is required for the application of this very simple procedure, the mechanical principles of which are set forth in the outline sketch.

VITAL FACTORS IN THE MANAGEMENT OF PROSTATIC OBSTRUCTION*

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THE vital factors in the management of the prostatic, demanding serious consideration, concern both palliative and operative measures. It is agreed,

naturally, that there is a definite group of patients with prostatism, in which operation should not, may not, and cannot be done. To this group, obviously, belong the incipient cases of obstruction, those that are organically and constitutionally unfit for operative intervention and those who refuse operation; collectively they constitute the so-called catheter-life class. It is quite generally recognized that the welfare of this group can be materially promoted by proper diathetic and hygienic measures and by assiduous care in the aseptic employment of catheters and other urethral instruments. That the choice, care and sterilization of instruments; that discrimination between intermittent and continuous catheterization and the frequency and change, respectively, of the

same, or decision between cystotomy and catheterization, that urinary antiseptics, diuretics, hematinics and tonics are important and that gentleness, patience, perseverance and sweet oil, are all vital factors that prolong life, need no particular emphasis. Nevertheless, too often do we see irreparable damage from trauma and infection, due to inexperience and indiscretion. Admittedly, the practice of medicine is both an art and a science, and I am pretty well convinced that there is greater opportunity for art in urology than in some other medical fields, and am quite certain that we ourselves are

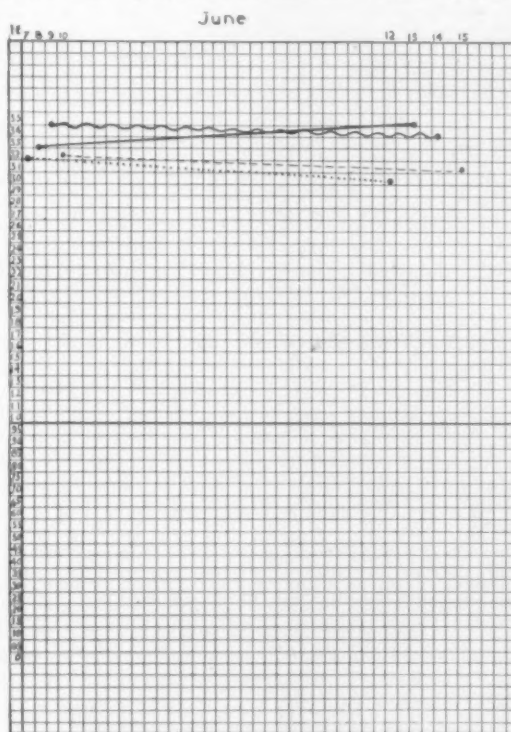


FIG. 1.—Normal case showing parallelism of indices of Elimination of indigocarmine and phenolsulphonephthalein. Indigocarmine: intramuscularly——; intravenously----- . Phenolsulphonephthalein: intramuscularly ~~~~~; intravenously..... .

* Read before the Brooklyn Urological Society, March 8, and the Philadelphia Academy of Surgery, May 2, 1927.

frequently remiss in its full application to our daily work. It is not an uncommon experience to-day to have patients on catheter-life for ten, fifteen or more years. Such a régime implies and necessitates the most efficient urologic care and rigid antisepsis.

There can be no urologic surgeon to-day, who questions the fact that the prospect of the qualified prostatic is infinitely better from operation than from any form of palliative treatment. It has been estimated that 50 per cent. of prostatics die in five years of the onset of obstruction, and that

catheter life shortens this to two and a half years. Obviously there are many notable exceptions to this dictum, but the fact remains, that life expectancy from catheter-life runs a poor second to the results following operation, with a mortality of three to five per cent. Moreover, the advantages of operative treatment, aside from those of vital statistics, from the standpoint of morbidity alone, would seem to justify the Golden rule: *operate if you dare to and catheterize only if you must*. It is truly a magnificent tribute to urologists, that, con-

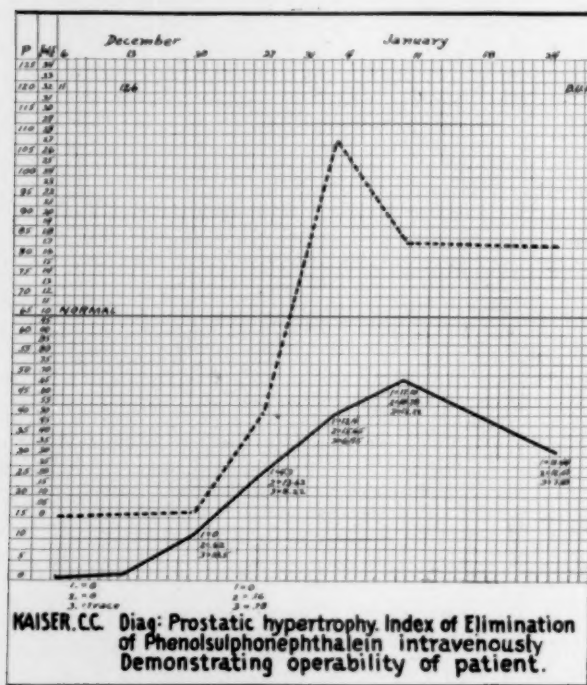


FIG. 2.

considering the age and decrepit state of the average prostatic, that by virtue of advances, chiefly in the preliminary care of these patients, that mortality has been brought so low. It would appear that if further progress is to be made in this respect, prostatectomy must be likened to appendicectomy, and operative measures be resorted to earlier, before other organic complications supervene.

Of importance, rivalling the determination of the operability of the prostatic, is the exact determination of the type of obstruction and the extent of the pathology. Upon this differentiation rests, or should rest, the decision as to the route, or particular type of operation, to be executed in the given case, and this in itself will materially lessen morbidity and mortality. It is a well-recognized fact that approximately ten per cent. of patients with prostatism do not present the classical hypertrophy of the gland so readily diagnosed by rectal palpation, but, on the contrary, belong to that no less

VITAL FACTORS IN MANAGEMENT OF PROSTATIC OBSTRUCTION

important, although smaller, group characterized by the French as "prostatisme sans prostate," wherein the pathology is usually some form of bar or glandular obstruction at the internal vesical orifice, incapable of exact diagnosis except by cysto-urethroscopy.

The cystoscope, furthermore, will frequently reveal intravesical pathology that will itself decide the route and extent of operative intervention. One of these revelations may be carcinoma, a consideration of which, however, is a chapter unto itself, and will not be discussed at this time; another may be syphilis, and should always be taken under advisement in urinary retention with impalpable prostate; others are diverticulum, hypertrophy of the trigone, tumors, calculus and various obstructions or bars at the vesical orifice.

In a consideration of prostatic obstruction, one may be so engrossed with the study of the particular type of lesion present, as to overlook concomitant pathology, that transcends in importance the prostate itself. The amount and duration of residual urine, and the force with which it is expelled per catheter, are factors often indicative of the extent of bladder damage, which if irreparable, will preclude

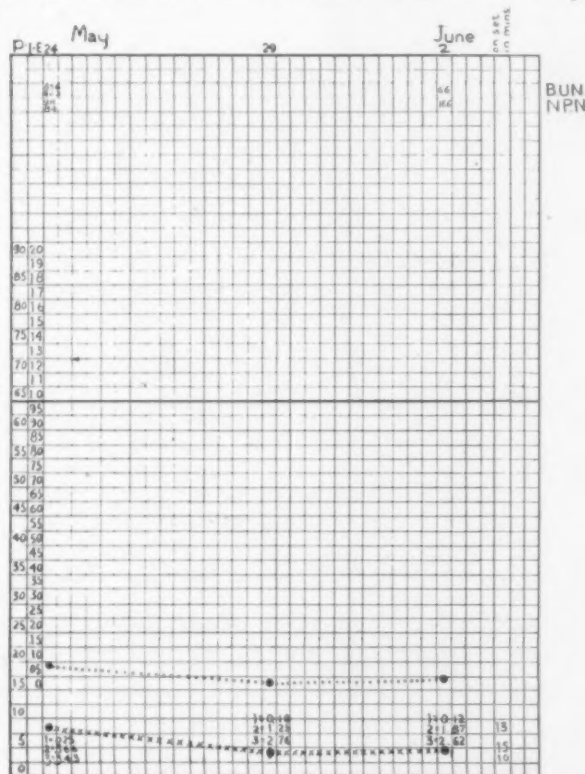


FIG. 3.—J. Huston. Diag. prostatic hypertrophy. Index of elimination of phenolsulphonephthalein intravenously. Demonstrating inoperability of patient.

a prognosis to the patient, that by operation he will be cured of all his ills. Such unfortunates, fortunately few, will continue to have frequency, harbor infection, and require catheterization and irrigations, or die prematurely. In this connection, I must allude to hypertrophy of the trigone, with pouching of the bladder posteriorly. I have seen and operated three such cases, and believe the condition to be secondary, invariably, to retention of urine, due usually, although not always, to obstruction at the vesical orifice by the prostate or in the urethra. The first case presenting this condition to come under my observation and treatment three years ago, was one of obstruction at the vesical orifice due to prostatic calculi. I have seen and operated two other patients with marked trigonal hypertrophy the past year; both cases of

obstruction, one glandular, the other fibrotic. The vis a tergo pressure, damaging kidney function and leading to hydronephrosis in these cases of urinary retention, aside from the more immediate threat, when it exists, of ascending infection, pyelitis, pyelonephritis and uremia, not to mention the remote effects on the heart, circulation and lungs, all constitute the possible pathology of the prostatic and are vital factors of first magnitude,

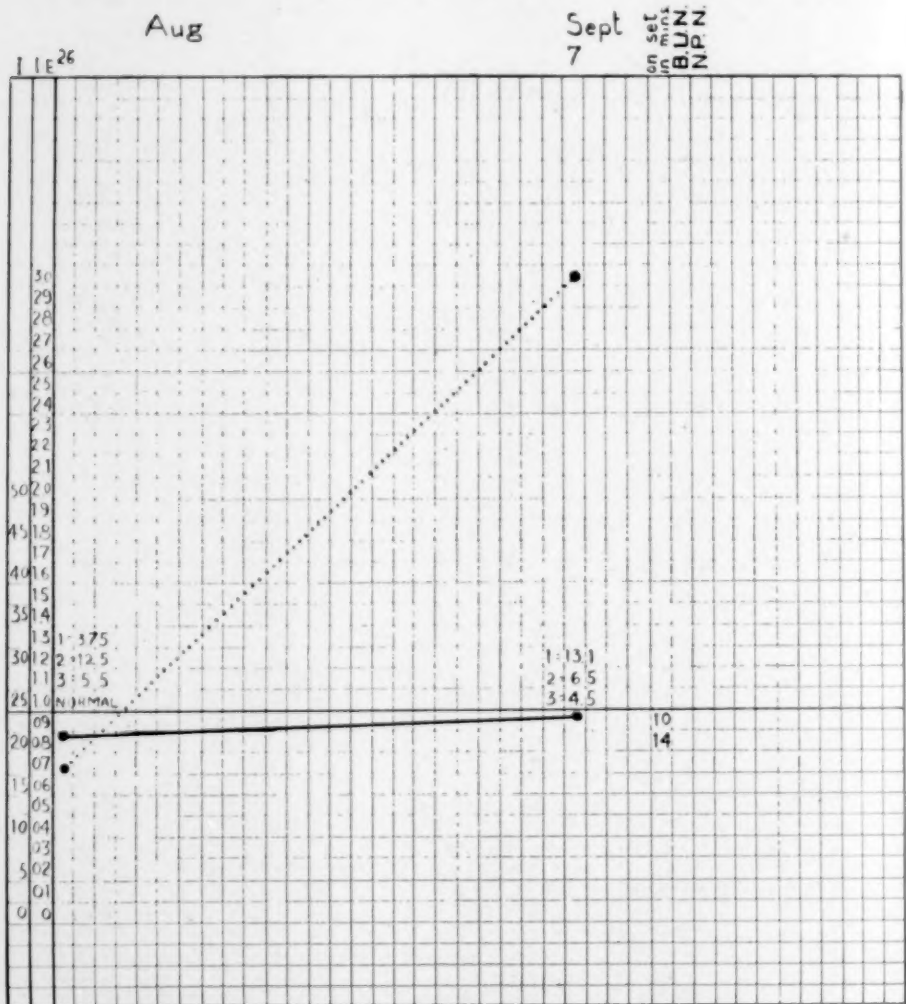


FIG. 4.—F. Stern. Diag. prostatic hypertrophy. Index of elimination of indigocarmine intravenously. Showing rise into positive phase and operability of patient.

when present, but need no emphasis before this audience, for the efficient management of the patient with prostatic obstruction.

Vital factors of great importance come into consideration, in determining the qualifications of the patient for operation. They constitute the estimation of the fitness of the patient for immediate, or deferred operative intervention, or inoperability, because of organic disqualifications. The most

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important of these, because at one time the commonest cause of death following prostatectomy, is the determination of the kidney function. Without recounting the various and numerous so-called tests of retention and elimination for this purpose, suffice it to say that the majority of urologists, to-day, are content with the estimation of blood urea nitrogen and the quantitative percentage output of phenolsulphonephthalein. Absolutely normal

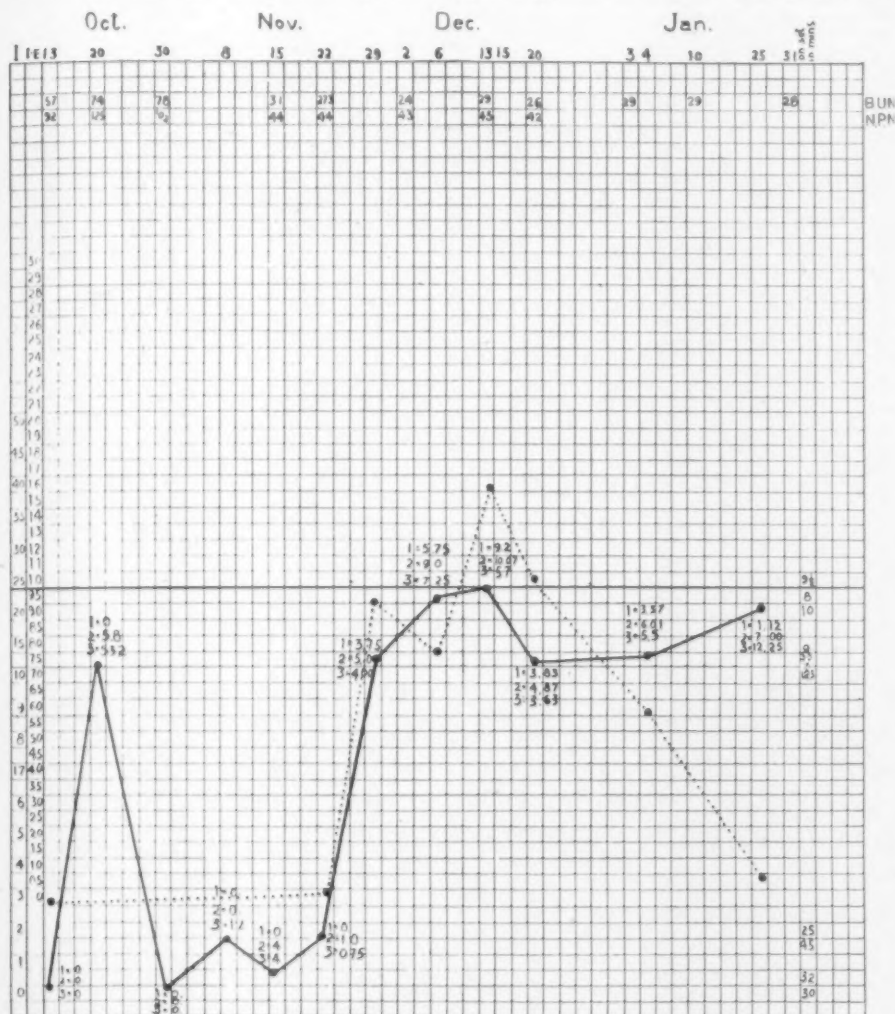


FIG. 5.—A. Huston. Diag. prostatic hypertrophy. Index of elimination of indigo carmin intravenously. Demonstrating inoperability of patient.

values of blood urea nitrogen range from 12 to 20 mgm. per 100 c.c. of blood; safe values 20 to 30 mgm.; values above 30 mgm. should be regarded as dangerous, if not prohibitive, of operation. Relative to phthalein or other substances employed, quantitatively, to determine the kidney function, absolutely safe operative values, so far as I know, have never been laid down. It will not be doubted that a patient with a quantitative output of 10 per cent. last

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week, 15 per cent. this week and 20 per cent. next week, is a far better operative risk, than a patient with an output of 50 per cent. last week, 40 per cent. this week and 35 per cent. next week. Thus our aim should be to determine the *stability of kidney function*. This of course can be and is

FIG. 6.
Blood Pressure Readings in a Series of Prostatectomies

Systolic		Diastolic		High pressure cases	
A	B	A	B	Systolic	Diastolic
165	135	120	80	(198)	(96)
135	158	80	95	185	80
162	138	93	70	192	95
185	170	80	120	184	86
145	120	80	60	190	90
(198)	130	(96)	70	165	120
142	140	90	84	175	120
175	184	120	86	156	102
152	144	85	72	150	100
170	115	98	72	170	120
156	140	78	80	154	116
115	135	70	80	170	100
155	170	90	90	<i>Rule</i> —When the systolic blood pressure is 180 or above, the diastolic must be under 100; when the diastolic pressure is over 100, the systolic must be 175 or less.	
152	146	85	98		
123	(102)	70	(58)		
156	110	102	65		
120	155	70	90		
167	160	90	95		
155	132	95	95		
116	140	80	85		
130	150	85	88		
135	130	80	65		
115	140	65	95	<i>Low pressure cases</i>	
153	118	60	68		
128	132	85	86		
100	105	70	65		
148	128	65	98		
115	154	50	116		
155	120	85	94		
122	126	60	75		
145	118	75	74		
145	170	88	100		
134	146	78	84	<i>Rule</i> —When the systolic blood pressure is 110 or lower, the diastolic must be over 60; when the diastolic pressure is under 60, the systolic must be over 110.	
148	190	85	90		
140	170	98	55		
120	125	70	85		
110	152	75	80		
115	109	80	76		
130	160	80	95		
150	160	100	90		
192	138	95	68		
150	144	65	82		

The figures in parenthesis represent fatal cases.

estimated by repeated quantitative determinations over a period of time, but reliance, in patients with damaged kidneys, cannot be placed upon a single quantitative test.

I desire to bring to your attention again, after ten years of probation, what I have called the *index of elimination*, for the determination of the

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functional integrity of the kidneys, believing steadfastly, that from a single estimation, it gives a truer value of the stability of renal function than a quantitative determination alone. The *index* may be defined as the measure of the ability of kidneys to perform a certain load in a given time, against normal. (Fig. 1.) It is computed by taking the ratio of the percentage output of the dye for the first and third thirds of the cycle of major elimination. Normally, the index averages about five, that is, there is five times as much output in the first, as there is in the third third of the cycle of elimination, during the first hour immediately after intravenous injection. It is a fractional determination, based upon twenty-minute periods of observation, and its value lies in the fact, that when the kidneys are damaged, the output of phthalein, indigo, or other substance is delayed, the duration of its elimination relatively pro-

longed, and hence the quantitative output for the first part of the cycle of elimination diminished, sometimes to the vanishing point. When the quantitative output for the first twenty-minute period is greater than, or at least equal to, that of the third period, there has been no urea nitrogen retention in the blood and patients invariably have demonstrated an excellent renal function, and are con-

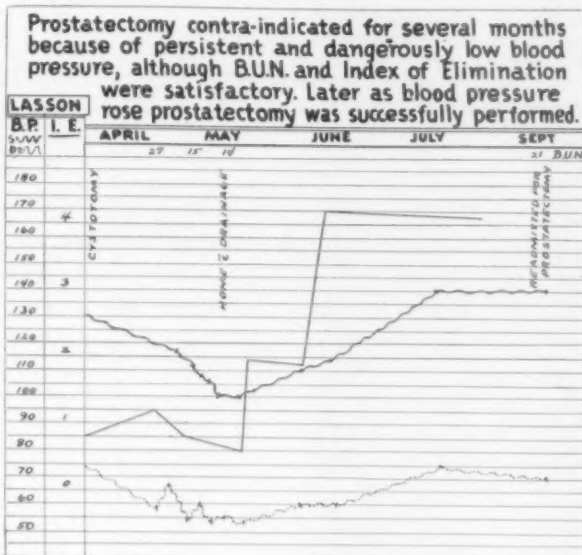


FIG. 7.

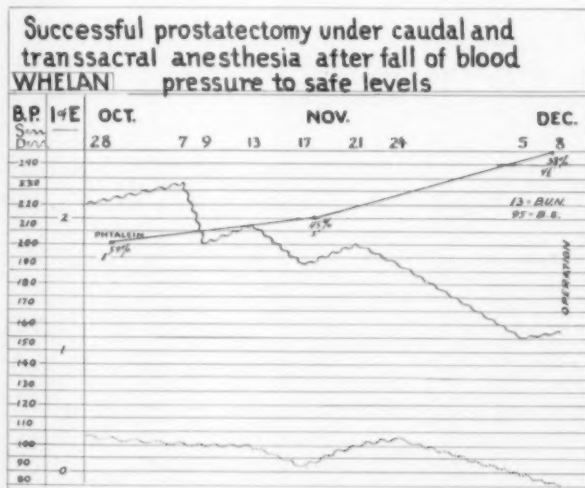


FIG. 8.

considered to be in the *positive phase* for operability; when the output of the dye for the first period is less than that for the third period, the index is obviously less than one; the kidneys are damaged, the patient is in the *negative phase*,

and operation is contra-indicated. Everything depends upon the accuracy of these functional quantitative determinations. The index, or the curve of the indices, in a given case, unquestionably gives a more pronounced, graphic portrayal of the kidney status than the mere quantitative readings—a fact readily demonstrable in the charts. (Figs. 2, 3, 4 and 5.) Indeed, simply by equal dilution of the first and third twenty-minute period specimens, and by observation against the light, it is possible to decide, at once, whether or not the patient is in the "positive" or "negative" phase for operative intervention—no colorimeter is necessary.

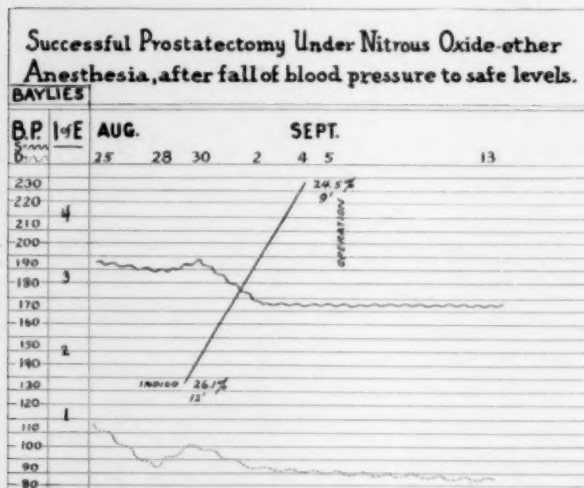


FIG. 9.

Next to kidney function in importance, as a vital factor in the determination of the qualifications of the prostatic for operation, stands the consideration of the condition of the cardio-vascular system and the blood. Obviously, an acute or advanced endo- or myocarditis, particularly, if attended by lost compensation, would preclude the advisability of operative treatment. From the surgical standpoint, a far more important consideration, frequently encountered, is the question of blood-pressure. I have also stressed this matter on more than one occasion in the past, and as a result of studies into the deaths of prostatectomies, have become confirmed in the following beliefs relative to low and high pressures, in their relationship to successful surgical intervention. (Fig. 6.) *In low tension cases, when the systolic blood-pressure is 110 or less, the diastolic must be over 60; when the diastolic pressure is less than 60, the systolic must be over 110. In high-tension cases, when the systolic pressure is 180 or more, the diastolic must be less than 100; when the diastolic pressure is over 100, the systolic must not be over 175.* This is not so called "pulse pressure," in its usual sense, but rather *pulse pressure with systolic and diastolic limitations.* We have repeatedly, successfully, operated cases with a systolic pressure of less than 110, or even 100, but the diastolic was always over 60; conversely, there have been cases with a diastolic of less than 60, but the systolic was always over 110. (Fig. 7.) On the other hand, operation with a systolic pressure over 190 is a hazardous procedure, but we have done it successfully several times when the diastolic was under 100 (Figs. 8 and 9); conversely, many cases with a diastolic over 100 and as high as 120, have been prostatectomized with recovery, but the systolic has invariably been less than 175.

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There are certain conditions of the blood other than nitrogen retention that deserve attention. Even such trivial matters as routine Wassermann tests and determination of the coagulation time of the blood, may enable the patient to receive appropriate antisyphilitic treatment, fortifying his chances for, or even saving him the experience of an operation, and promoting his convalescence; rarely in the detection of a bleeder, life itself may be spared. I have made the examination of the blood for sugar a routine procedure, and have been repaid in a number of cases by finding

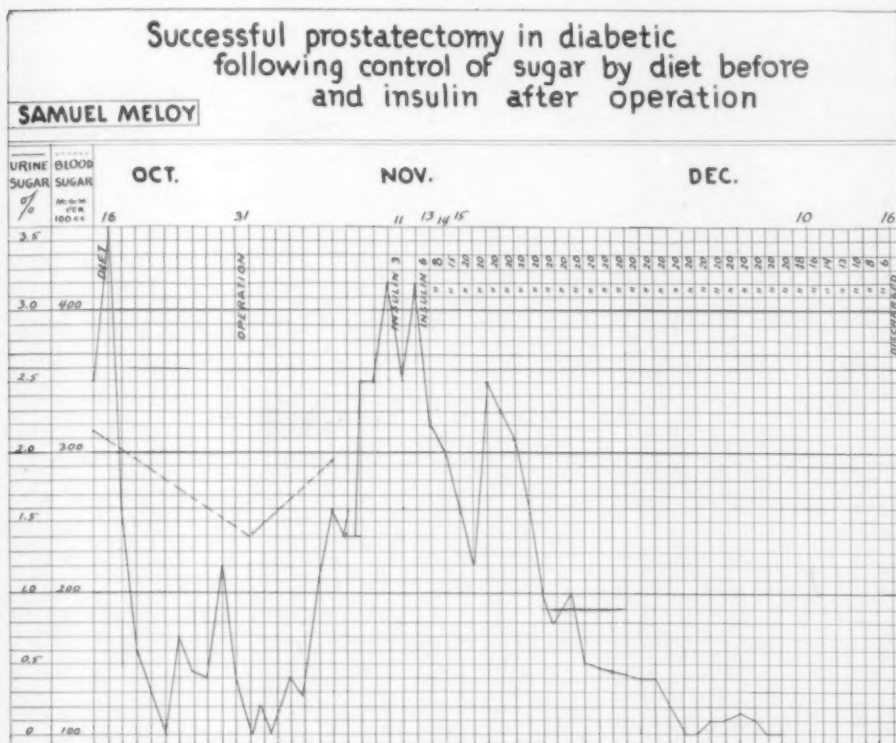


FIG. 10.

hyperglycemias, in the absence of sugar in the urine. The proper dietetic régime, with or without insulin, has sufficed in a number of cases to make surgery safe for these diabetics. Figure 10 represents the diabetic chart of a prostatic, whose urinary sugar prior to operation was controlled by diet, but after operation insulin became necessary and doubtless saved his life. I have also seen a number of patients markedly debilitated and gravely anæmic from the agonies of prostatism, in whom it was possible, in the course of a few weeks of pre-operative treatment, to bring their blood pictures up to normal and safe operative levels. Figures 11 and 12 show the curves of the red blood-cells and hæmoglobin in such cases. By virtue of the parallelism between these two curves, it is not routinely necessary to have the erythrocytes counted. Figures 13 and 14 will illustrate the hæmoglobin

curve in comparison with the index of elimination of phthalein and the blood-pressure of patients qualifying for prostatectomy.

Another vital factor of moment is the nervous system. Organic disease of the central nervous system, as tabes, multiple sclerosis, etc., is easily recognized and should not complicate the management of the prostatic. There is, however, a functional nervous disorder, namely, uncontrollable fear of death, that may itself contra-indicate operation. I have seen two prostatectomized patients die from this cause alone. Panic-stricken with fright, death ensued from nervous shock and exhaustion.

Few patients will be disqualified from the pulmonary standpoint, because of emphysema, hypostatic pneumonia, malignant metastasis, or an old chronic phthisis. Certain pulmonary, like cardiac, contra-indications to general surgical anaesthesia, can be overcome by resort to caudal and transsacral narcosis.

Likewise, the gastrointestinal tract seldom is a factor in prohibiting surgical intervention on the prostatic. Rarely carcinoma, chronic gastroenteritis or extreme intestinal stasis will forbid surgical attack.

Age, *per se*, is never a vital factor prohibiting surgery of the prostate. A man is never any older than his organs, and if they are determined to be fit, mere years are no criterion.

Many men are older at fifty than others are at seventy, and some at eighty are younger than others at sixty. Physical dissolution, general organic exhaustion or true senility, assuredly, will preclude any thought of radical surgery.

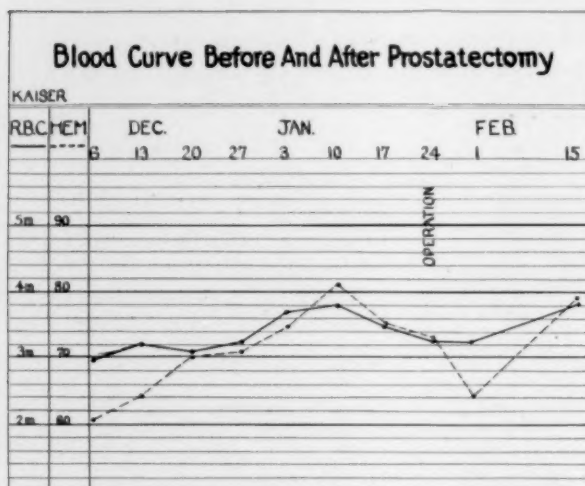


FIG. 11.

Improvement in blood incident to pre-operative care of the prostatic

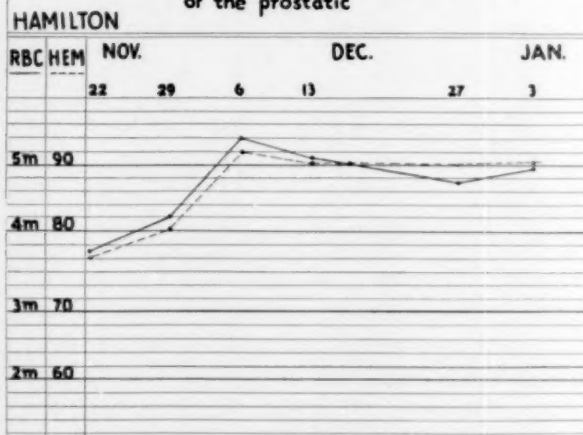


FIG. 12.

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I believe the vast majority of surgeons, general and urologic, to-day favor suprapubic prostatectomy when there is a preponderant enlargement of the median lobe, or general hypertrophy of the gland, or when other intra-vesical complications exist, as stone, tumor, diverticulum or trigonal hypertrophy. When the hypertrophy is confined to one or both lateral lobes, or the gland is small, fibrotic and presumably densely adherent, undoubtedly it should be removed perineally. (Fig. 15.) I have repeatedly known patients to be cystotomized for prostatectomy and the prostate found to be so small that its enucleation, suprapubically, was pronounced impossible, and the operation terminated.

Such surgery would not and could not be done, if patients were properly cystoscoped and more discrimination exercised as to operative route. Again, in that not inconsiderable group, where by the cysto-urethroscope the obstruction

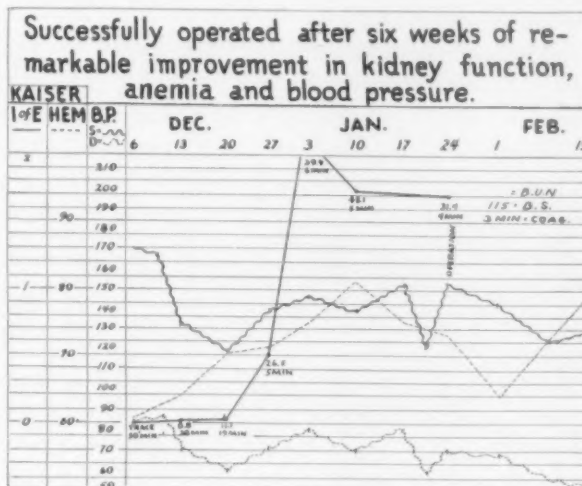


FIG. 13.

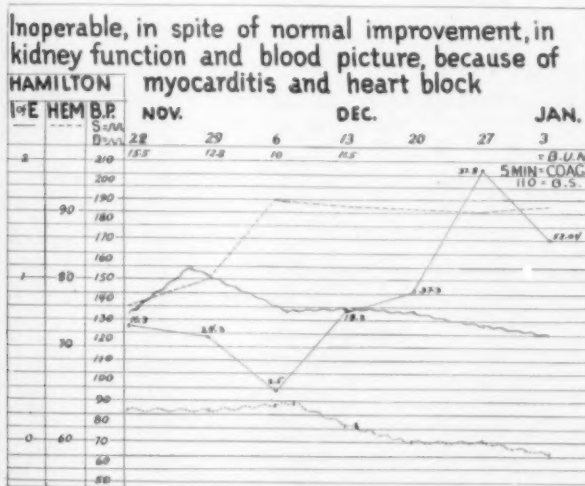


FIG. 14.

better execution under direct vision may be, time only will determine. In many such cases, the orificial obstruction can be more effectively and thoroughly removed suprapubically, by punch or rongeur, with less danger from infection and hemorrhage. (Fig. 16.)

of the bar or glandular type, some form of so-called "punch operation" or intra-urethral procedure, as fulguration, cold or hot punch (Young, Caulk, Braasch) or incision or resection with the electric knife (Collings, Stern), should be employed. How much of a reversion to the discarded practices of Freudenberg, Bottini and Chetwood, these newest procedures, granting

Doubtless everyone will recall that it has been but a few years since prostatectomists were divided into two schools, one that insisted on operating all cases perineally, the other that was wedded exclusively to the suprapubic route. On *a priori* grounds, it was obvious that both could not be right, and for fifteen years I have spoken, written and reiterated the thought, that more discrimination should be exercised, depending upon the pathology present, with respect to selection of the proper operative route in the given case, thereby reducing morbidity and further lowering mortality. If the surgeon will prepare himself impartially to operate suprapubically, perineally, or per urethrally by whatever modality, and stand unbiased and unfettered by training, experience or tradition to operate the patient according to his needs, rather than to fit the victim to operation, to which he is irrevocably wedded

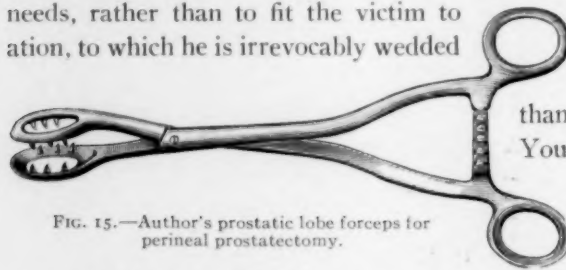


FIG. 15.—Author's prostatic lobe forceps for perineal prostatectomy.

any particular type of operation by reputation, I am positive that even better results, than obtain to-day, will accrue. You have all seen unsatisfactory results from the suprapubic, perineal and "punch" operations, due to incomplete

removal of the offending obstruction. I have operated successfully, by another route, not a few prostatics, primarily operated elsewhere with indifferent results. Exercising all the discrimination possible, with respect to the type of operation to be done in given cases, I also have had the misfortune and humiliation of unsatisfactory results in my own work, necessitating re-operation by a different route. Thus it is evident, that in spite of the greatest care and impartiality in the management of these cases, unsatisfactory results will occur occasionally. Let us endeavor to keep them at a minimum. My experience shows that about 80 per cent. of cases have been operated suprapubically and about 20 per cent. perineally. Almost all bar and glandular obstructions have been removed by "punch" or rongeur *via* suprapubic cystotomy. Caulk, on the contrary, believes that over 30 per cent. of all cases of prostatic obstruction can be successfully treated by the cautery punch, thus eliminating cystotomy in a very high percentage of patients.

The factor that has done most to conserve life in the management of the prostatic, and has been responsible in the past quarter of a century for a reduction of mortality from approximately 50 to less than 5 per cent., is drainage of the bladder to facilitate decompression of the kidneys, and the readjustment of their temporarily damaged function by urinary back pressure. Every surgeon, to-day, I trust, has a full appreciation and realization of this fact. However, there still seems to be considerable difference of opinion and practice, as to the best way of effecting this drainage, whether by catheter or cystotomy. Assuredly, there are many cases where primary cystotomy or so-called "two-stage" prostatectomy is the method of choice

VITAL FACTORS IN MANAGEMENT OF PROSTATIC OBSTRUCTION

and a life-saving measure. On the contrary, in the large majority of patients, it should not be routine, and is unnecessary from the standpoint of economy, if for no other reason. In my experience, it has amounted to not more than 10 per cent. The decision as to whether periodic or continuous catheterization

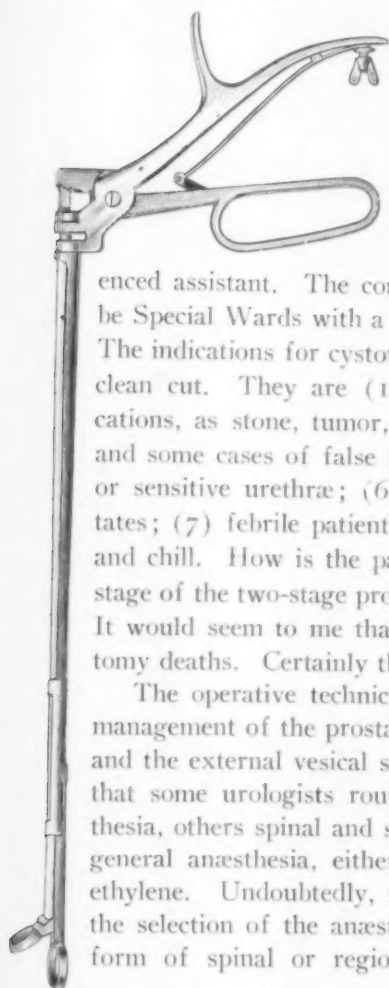


FIG. 16.—Author's suprapubic prostate punch. An enlargement of Hartmann's tonsillar punch; most effective for the suprapubic removal of prostatic bars and obstructions.

or cystotomy for drainage is to be employed, should not rest upon the inexperienced efforts at catheterization by the average hospital interne or resident physician. Many patients pronounced uncatheterizable, or are intolerant to the catheter in the hands of the hospital interne, will tolerate, most satisfactorily, catheterization by an experi-

enced assistant. The complete and final answer to this problem will be Special Wards with a trained personnel, interested only in urology. The indications for cystotomy over catheterization are very simple and clean cut. They are (1) marked cystitis; (2) intravesical complications, as stone, tumor, clots, etc.; (3) epididymitis; (4) stricture and some cases of false passage of the urethra; (5) unusually small or sensitive urethra; (6) unusually obstructive or impassable prostates; (7) febrile patients or catheter cases developing urethral fever and chill. How is the patient dying following cystotomy as the first stage of the two-stage prostatectomy to be rated in mortality statistics? It would seem to me that such cases must be regarded as prostatectomy deaths. Certainly they will be so considered by the laity.

The operative technic is perhaps the least important item in the management of the prostatic, provided standard methods are followed, and the external vesical sphincter is preserved. I recognize full well, that some urologists routinely employ caudal and transsacral anaesthesia, others spinal and still others, doubtless the majority, adhere to general anaesthesia, either nitrous oxide, with or without ether, or ethylene. Undoubtedly, more discrimination should be exercised in the selection of the anaesthetic for the particular case, whether some form of spinal or regional or general. I am convinced that no absolute rule employing the same form of anaesthesia for all cases is best. Certain cardio-vascular, renal and pulmonary cases, unquestionably, should be delegated to spinal, regional or other form of narcosis. The vast majority, if properly prepared, stand general anaesthesia under gas, or even ether, very satisfactorily, with no higher death rate than from other forms of anaesthesia. Much depends upon the efficiency of the anaesthetist.

Hemorrhage is not an infrequent cause of death, and much might be said about haemostasis. The pneumatic bag of Hagner, Pilcher or Ballenger, has its field of usefulness, but suture ligation of the bleeding point, at the time

of operation, is the best and most trustworthy procedure. Packing of the bed of the prostate is the least desirable method and very rarely necessary.

Owing to the incidence of epididymitis as a complication of prostatectomy, some urologists to-day are routinely ligating the vasa differentia or performing vasectomies, prior to or at the time of prostatectomy. I feel that the incidence of epididymitis does not warrant this. When the complication occurs, it has seldom, in my experience, protracted convalescence. Ligation of the vas or vasectomy might, at least, be reserved for recurrent cases.

Suction drainage, a few years ago, threatened to be a universal practice. To-day, with other more simple and less costly devices, with equally good results, it seems not to be an essential. (Fig. 17.)

There is no doubt that the post-operative care of the prostatic is equally as important as the pre-operative or operative, and this is where the urologist frequently has opportunities to display his ingenuity as a plumber of mankind. Saline and glucose solutions, diuretics and cardiac tonics, especially digitalization, save many lives. A great many patients that "go bad" during convalescence, do so, because of improper bladder hygiene. Thorough vesical irrigations, when infection exists, will prevent the development of many cases of pyelitis and pyelonephritis. Finally, do not force these old men out of bed too soon. Many complications of epididymitis and a few of phlebitis and embolism will thereby be averted.

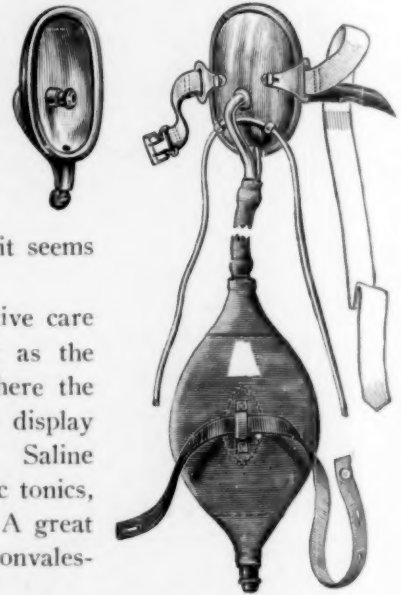


FIG. 17.—Author's suprapubic drainage cup. Routinely used in all suprapubic prostatectomies; a detachable rubber ring cushion applicable to the rim of the cup is not shown in the cut.

GONOCOCCUS EPIDIDYMITIS

OBSERVATIONS IN THREE THOUSAND CASES FROM THE UROLOGICAL
SERVICE OF BELLEVUE HOSPITAL

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GONOCOCCUS epididymitis is the most common disease of the testicle. The morbidity is high since sterility following bilateral involvement is frequent. Usually the onset is acute, pain is excruciating and the patient welcomes his bed. An associated urethral discharge suggests the diagnosis; demonstration of the gonococcus confirms it. Treatment is (1) palliative—immobilization of the scrotal contents—or (2) surgical. Epididymotomy affords immediate relief from pain. One in fifteen require operation. Observations on all phases of this disease with particular attention to and evaluation of the various methods of treatment employed in three thousand cases admitted to the Urological Service of Bellevue Hospital are here presented.

Gonorrhœal involvement of the posterior urethra and its associated structures (prostate and seminal vesicles) precedes the epididymitis in all cases even though the appearance of the urethral discharge succeeds the onset of the epididymitis. Several cases of the latter type have been observed and this apparent deviation from the usual sequence betrays a latent posterior infection. We have seen it twice. In eleven of our cases the onset of discharge and epididymitis occurred the same day. The incidence is greater,

TABLE I.

Interval Between Appearance of Urethral Discharge and Epididymitis—Surgical Cases.

	0	1	2	3	4	5	6	7-12	Total
Days	3	3	4	4	6	7	5	.....	32
Weeks		32	35	29					96
Months		21	15	7	10			8	61
Over 1 year									10
Not stated									9
									209

Non-surgical Cases

	0	1	2	3	4	5	6	7	8	Total
Days *	8			84				53		145
Weeks		239	374	311	458	119	239	42		1782
Months			268	269	143		27		38	745
Over 1 year										37
Not stated										58
Denied										22
* Epididymitis preceding discharge										2
										2791

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however, between the second and eighth week of the gonorrhœa, particularly the second to fourth. (Table I.) It is to be noted also that one attack predisposes to succeeding infections of the epididymis. Two hundred and forty-eight of these patients suffered previously with epididymitis, practically always on the same side. Over half (58 per cent.) have had previous gonorrhœas. (Table II.)

In the presence of a deep urethral infection, too forceful injections, the passage of instruments, vigorous prostatic massage, exposure to cold, sexual

TABLE II.

<i>Previous Epididymitis</i>			<i>Previous Gonorrhœa</i>	
Times	Surgical	Non-surgical	Surgical	Non-surgical
1	31	.....	67	1001
2	4	.....	14	408
3	2	.....	5	91
4	..	Same side..... 145	1	48
5	1	Other side..... 64	1	32
6	..		1	8
7	1	209	..	6
over 7	..	.....	5	52
	39		94	1646

209 surgical cases
2791 non-surgical cases
3000 total

or alcoholic excess may incite epididymitis. Not infrequently direct trauma to the testicle apparently predisposes.

The incidence of this complication may be appreciated by the observation that of 225,000 male admissions to Bellevue Hospital, during the eight-year period on which this study is based over 3000 suffered with gonorrhœal epididymitis, a ratio of one in every seventy-five male admissions.

The incidence is highest during the third decade, the period of greatest sexual promiscuity, particularly between the ages of twenty and twenty-five years. After forty, the condition is rarely encountered. Our oldest patient was sixty-six, the youngest fifteen. Between 20 and 30 per cent. of gonorrhœas develop epididymitis. The ages of our patients in this study are indicated in Table III.

TABLE III.

Age	<i>Ages and Cases of Gonorrhœal Epididymitis</i>	Cases
15-19.....		152
20-24.....		1231
25-29.....		893
30-39.....		592
40-49.....		84
50-59.....		19
60—and over.....		7
Not recorded.....		22
		3000

GONOCOCCUS EPIDIDYMITIS

The right side is apparently more often involved than the left. In this series the ratio is 1494 to 1309. Bilateral involvement was noted 192 times. (Table IV.)

Pathology.—The migration of the infection proceeds from the meatus posteriorly to the deep urethra thence through the ejaculatory ducts down

TABLE IV.

Side involved	Non-operative cases	Operative cases
Right.....	1390	104
Left.....	1229	79
Bilateral.....	172	26
	2791	209

the lumen of the vas to the epididymitis. Extension of a posterior infection through the lymphatics surrounding the vas may also take place, for we have seen three cases which developed non-gonorrhœal epididymitis (post-prostatectomy) one, three, and four weeks after resection of the vas. The occurrence of localized infection in the epididymis secondary to gonococcæmia has never been proven.

Pathologically, gonococcus epididymitis is nearly always an acute process. On opening the tunica vaginalis, hydrocele fluid often escapes. Fifty-three of the two hundred and nine operated cases in which this finding was recorded showed fluid in amounts varying from 5 c.c. to four ounces. Fibrin in amounts of one dram to three ounces was noted eight times, although it unquestionably occurred more often. Four times sero-sanguinous fluid was found. Free pus was present within the tunica vaginalis six times. (Table V.)

In the early stages, the greatest involvement is found in the globus minor. When mild the infection is limited to this part. When severe,

TABLE V.

Surgical Pathology

Hydrocele present	Times
1—Fluid: 1 dram to 8 ounces.....	53
2—Fibrin: 1 dram to 3 ounces.....	8
3—Fibrin: (Organized) ½ ounce to 1 ½ ounces.....	4
4—Sero-sanguinous fluid.....	4
5—Free pus in tunica vaginalis.....	6
Pus in epididymis	
Minims 1-15.....	51
C.C. 16-30.....	10
Sero-sanguinous or seropurulent fluid.....	10
Pus found (amount not given).....	27
Abscess of testicle.....	4
Not found nor recorded.....	107

extension to the globus major ensues and often many punctate abscesses are present. By coalescence of these abscesses the entire organ is frequently converted into one suppurating mass. Intense injection of the tunica vaginalis may be seen, but it should be noted that the testicle itself is not involved in the process save by collateral injection of the tunica albuginea. There-

fore, the term gonorrhœal orchitis is incorrect. However, associated abscess of the testicle is occasionally encountered late in the disease but when present develops by direct extension from an abscessed epididymis or is secondary to inflammatory thrombosis of the nutrient vessels of the cord. Not infrequently the cord is of thumb thickness, white and glistening in appearance from œdema, or may show localized abscesses along the vas, particularly in proximity to the tail of the epididymis. Such cord abscesses we found three times.

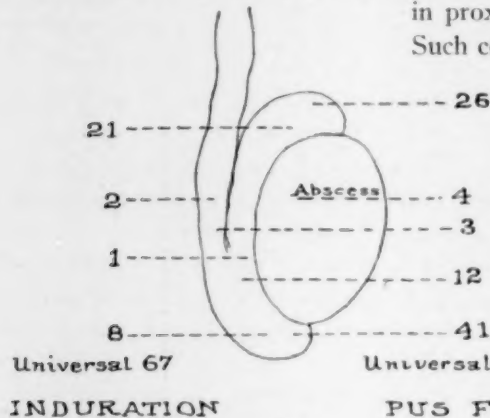


FIG. 1.

Microscopically the picture is that of an acute catarrhal inflammation, *i.e.*, desquamation of lining epithelium, infiltration of polymorphonuclears, plasma cells, and some lymphocytes with generalized œdema of all structures. The seminiferous tubules frequently show minute focal abscesses, sometimes involving but few tubules, more often involving many. Tubular occlusion by cellular debris or polymorphonuclears is seen. Some tubules are occluded by œdema. Peritubular leucocytic infiltration is also common. The more advanced the disease, the greater the tendency to focal abscess formation.

Of the 209 cases operated upon, regional involvement was greatest at the tail, but a surprisingly large number showed universal inflammation with great pain and without gross pus. (Table VI and Fig. 1.) It is to be

TABLE VI.
Surgical Pathology

	Inflammatory Involvement (No Pus)	Gross pus found
Head.....	21	26
Body.....	1	12
Tail.....	8	41
Universal.....	67	23
Head and tail.....	5	2
Head and body.....	—	—
Body and tail.....	—	2
Vas.....	2	3
Not recorded.....	105	90
Abscess of testicle.....		4 times
Sero-sanguinous fluid from epididymis.....		10 times
Cystic epididymis.....		5 times

noted, however, that examination of the sero-sanguinous fluid obtained on puncture of the epididymis in these cases reveals myriads of leucocytes. Examination of the pus or serum obtained has in the hands of many revealed the invading gonococcus. A few attempts to isolate this organism in this series have been unsuccessful.

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Symptoms.—Pain is the outstanding symptom in most instances. Quite commonly precursory groin discomfort, pain along the path of the cord, localized ache or sharp stabbing pain in the epididymis is noted many hours or even one or two days before the actual onset of the acute local symptoms. Cord pain is due in part to drag of the testicle but chiefly to cedematous swelling, particularly within the limited confines of the inguinal canal. Pain in the epididymis is severe, best described as sickening in character and may be referred to the lower back, rectum or the lower abdominal region. Motion exaggerates the discomfort. The walking attitude is characteristic, a forward stoop and a straddle gait. Not infrequently the patient finds relief by manual support of the testicle. There are sub-acute cases in which pain is minimal and the patient is oblivious to ought save a mild local swelling. This condition is not infrequent, and unquestionably is, as had been pointed out elsewhere,¹ a frequent cause of so-called idiopathic hydrocele.

The usual clinical course of acute epididymitis is one of an abrupt onset with gradual decline or resolution covering a period of three to five days after institution of proper treatment. The prehospitalization period of the acute disease in our patients is shown in Table VII. Most had the condition

TABLE VII.
Duration of Epididymitis Before Hospitalization.

Days	Non-surgical	Surgical
1.....	223	11
2.....	302	13
3.....	298	44
4.....	322	25
5.....	307	27
6.....	188	13
7.....	381	23
8-10.....	279	12
11-13.....	54	14
14-20.....	225	16
21-27.....	81	4
28-59.....	81	5
Over 60.....	36	2
Not recorded.....	14	
	2791	209

less than a week when they sought hospital care—one to five days was the duration before admission in half the cases.

Cases in which the temperature and pain does not decline within the three-to-five-day period after hospitalization we may usually and correctly diagnose abscess formation. These are best treated surgically.

There are those patients in whom the condition is essentially asymptomatic from onset but these are the unusual. On the other hand, the onset may be most violent with physical signs such as are commonly observed in the acute abdomen, as in two of our cases, or with exquisite pain in the epididymis with chills, fever, nausea, prostration and, rarely collapse.

Diagnosis.—As a rule the diagnosis is easily made by finding an acute

inflammatory process involving the epididymis in the presence of an urethral discharge. Demonstration of the gonococcus in the discharge is confirmatory for while acute epididymitis due to other organisms may occur, even in the presence of a gonorrhœal urethral discharge, such cases are most rare and open to question. The scrotum is swollen, often the seat of an acute hydrocele obscuring both testicle and epididymis. The scrotal skin is inflamed and œdematous, usually presenting a reddish-purple hue. The epididymis shows earliest thickening at the globus minor but as the infection proceeds, the entire organ may become involved and easily but tenderly palpable. Cord changes are the rule. (Table VIII.) Thickening was noted 774 times in

TABLE VIII.

Physical Examination—Spermatic Cord

	Non-surgical	Surgical
Normal.....	907	31
Tender and thickened.....	556	79
Tender.....	91	11
Thickened:		
Slightly.....	142	22
Moderately.....	295	41
Greatly.....	51	12
Painful.....	32	5
Vas:		
Thickened.....	10	2
Tender.....	5	3
Abscess.....		2
Acute lower abdominal pain with vomiting.....		twice

this series, tenderness of varying degree 463 times. Vas changes are those of induration with enlargement (seven times), occasionally with gross signs of localized abscess (twice).

Changes in the prostate are variable. Prostatitis may usually be correctly diagnosed on digital findings. (Table IX.) Seminal vesiculitis on

TABLE IX.

Physical Examination—Prostate

	Non-surgical	Surgical
Normal.....	162	17
Small.....	8	—
Enlarged and nodular.....	273	41
<i>Nodular</i>		
Slightly.....	21	4
Moderately.....	57	8
Greatly.....	12	1
<i>Enlarged</i>		
Slightly.....	72	10
Moderately.....	221	34
Greatly.....	38	6
Indurated.....	141	22
Tender.....	130	16
Boggy.....	162	13

the side of the epididymitis is characteristic, although at times conspicuously absent. Contralateral seminal vesicle involvement may be acute without

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palpable evidence of involvement of the mate we should expect to find diseased. (Table X.)

Urethral smear when positive for gonococci clinches the diagnosis but

TABLE X.

Physical Examination—Seminal Vesicals

	Non-surgical	Surgical
<i>Enlarged</i>		
Slightly.....	542	48
Moderately.....	109	18
Greatly.....	82	6
Enlarged and tender.....	141	10
Tender.....	26	9
Indurated.....	112	3
Involvement on opposite only.....	42	3
Negative.....	179	16

diagnostic exclusion of gonorrhœal epididymitis by negative smear is erroneous. The clinical findings are more reliable. (Table XI.)

Differentiation must be made between gonorrhœal, tuberculous and so-

TABLE XI.

<i>Laboratory Findings</i>	<i>Surgical</i>		<i>Non-surgical</i>	
	Smear	Wass.	Smear	Wass.
Positive.....	164	2	1372	21
Negative.....	21	9	101	82
Not recorded.....	24	200	1318	2687

called non-specific epididymitis (*B. coli*, staphylococcus, etc.), particularly in the subacute cases. Prostatic and seminal vesicle palpation, together with examination of the centrifugized urine for gonococci, tubercle bacilli or *B. coli* or other organisms may aid in making the diagnosis in difficult cases. The complement fixation test, generally positive within two weeks after onset of the epididymitis but always sooner or later, must not be overlooked. Tuberculin may rule out or prove a tuberculous infection. Testicular tumor, or luetic orchitis may simulate a subacute epididymitis. Torsion of the spermatic cord is often clinically quite indistinguishable from epididymitis except for absence of signs of a gonococcus infection.²

Prognosis.—The mortality is low. Death seldom follows gonorrhœal epididymitis, although a few fatalities from secondary peritonitis or septicaemia are on record. In this series there were no deaths.

On the other hand, the morbidity is high, particularly because so many of these patients are rendered sterile. Benzla³ in studying the offspring of German soldiers found that 10.5 per cent. of those who had gonorrhœa without epididymitis were childless; 23.4 per cent. with unilateral and 41.7 per cent. with bilateral epididymitis were childless. This suggests but does not prove male sterility. In cases of sterile marriages, the male is at fault 15 to 20 per cent. and unquestionably most of such sterility results from previous epididymitis (usually of venereal origin) with occlusion of the seminiferous

tubules. We are now engaged in a follow-up study of twenty-six bilateral operated and 172 bilateral unoperated cases in this series which will be reported later.

Treatment.—Prophylaxis aims to keep an anterior urethritis from

TABLE XII.

Treatment.

	Surgical	Non-surgical	Pain Relieved Hours after Suspensory	
Suspensory used.....	191	2339	1-4	418
Suspensory not used or not recorded.....	18	402	5-8	832
Aolin.....		50	9-11	362
			12	371
			18	22
			24	224
			30	22
			36	31
			48	57

becoming posterior. If posterior infection does develop, extreme caution and gentleness are essential in carrying out instrumentation. Certainly no instrument should enter the canal during the acute stage the prostate massaged.

epididymitis is present in full and the testicles immobilized. may relieve as will a hot water of the scrotal contents is, relief from pain. This is scrotal suspensory devised on vue as a modification of the The construction of this It is of adhesive tape of small roller bandage $2\frac{1}{2} \times 1$ high in the scroto-perineal support to the scrotal contents slipping downward. With this scroto-perineal angle, the lower through the gluteal folds over

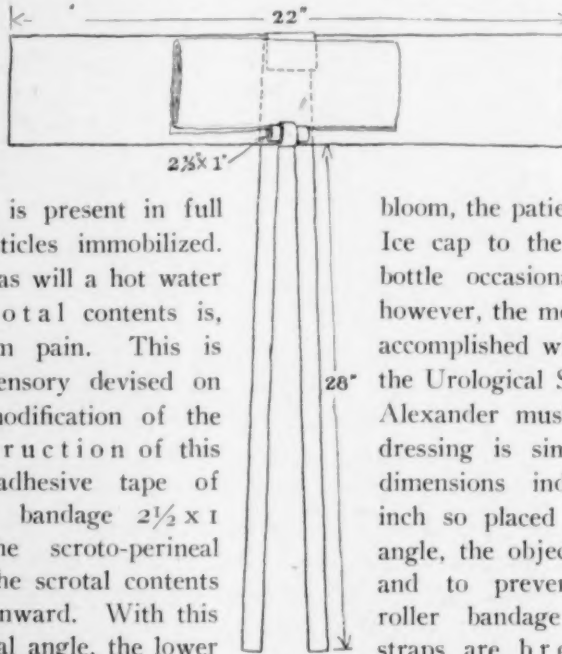


FIG. 2.

strap which in reality gives the suspension is brought up over the iliac crests (Fig. 4), thus holding the testicles high with firm support and complete immobilization. An additional cross strap suprapubically reinforces the dressing. This is the only dressing of which we are aware that will afford instantaneous relief from the acute pain of epididymitis.

To ascertain the best treatment for this condition certain therapeutic experiments were carried out at Bellevue. In 1924, Dr. J. J. Toomey made

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observations on the use of foreign protein by injection. A preparation called aolin was used. In a series of fifty cases thus tried no evidence was brought forth to prove superiority or particular value for this method of treatment. The average hospital stay of the aolin cases was 5.6 days, of those without aolin 5.4 days. If fifty cases treated without suspensory but with ice cap, pain persisted longer and the course of the disease was materially longer (6.8 days) than in those cases having suspensory. In 100 cases with suspensory, no difference was noted in the period of hospitalization in those fifty patients supplied with an ice cap and those fifty without. Those with the cold were more comfortable.



FIG. 3.

More recently observations have been made in a series using diathermy. While pain was often relieved in a comparatively short time, usually only

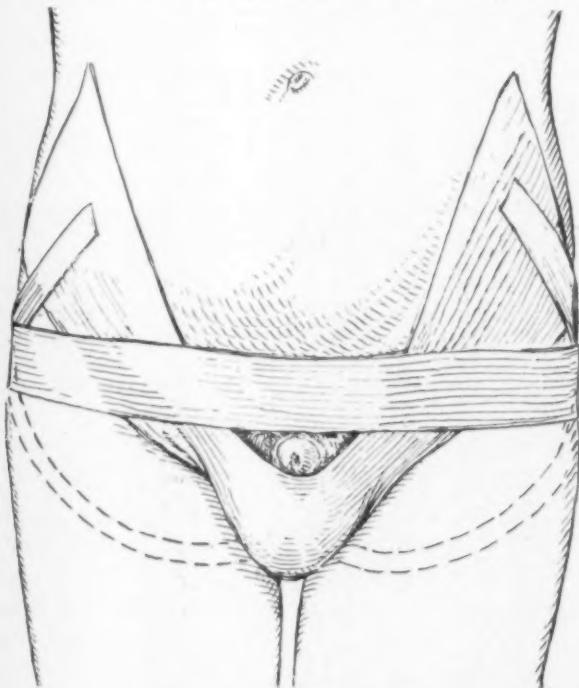


FIG. 4.

temporarily, the course of the disease was not shortened. As a result of this rather extensive therapeutic study we feel that the properly applied adhesive suspensory here described plus rest in bed is the best non-surgical treatment for gonorrhœal epididymitis.

A host of other therapeutic agents have been advocated. Vaccines—autogenous, stock or typhoid—in increasing doses every other day have been used with inconstant success. Applications of an irritant to the scrotum (quiacol 50 per cent. in glycerin is

most commonly used) serve but to irritate the skin. A tight rubber compression bandage about the scrotum producing a modified Bier's hyperæmia

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has been found useful by some. Sodium iodide intravenously has often been used, but neither at Bellevue nor elsewhere have we been convinced of its efficacy.

The problem of surgical treatment is unquestionably the most difficult—when to operate. At Bellevue the persistence of pain has become our criterion. (Table XIII.) If pain does not disappear within forty-eight hours

TABLE XIII.

Indication	Operation.	Anæsthetic
1. Pain and temperature.....	29	Local..... 22
2. Pain.....	161	Gas oxygen ether..... 18
3. Recurrence.....	9	Local to general..... 5
4. Abscess.....	4	Spinal..... 2
5. Not stated.....	6	

*

Type of Operation	
Epididymotomy.....	178
Epididymectomy.....	24
Orchidectomy.....	5
Resection of Vas.....	1
Additional operation:	
Hydrocele.....	1

after confinement to bed and application of the suspensory without local signs of abscess formation, the case is deemed surgical. Some time ago a non-subsiding temperature was the criterion, but pain has been found a much better guide.

On admission the temperature ranges between 99° and 102° in half the cases. (Table XIV.) After twenty-four hours in bed with suspensory

TABLE XIV.

			<i>Temperature.</i>		<i>Days to normal</i>	
Under 99.....			168	1		1724
99- 99.9.....			588	2		628
100-100.9.....			582	3		171
101-101.9.....			597	4		60
102-102.9.....			307	5		23
103-103.9.....			392	6		14
104-104.9.....			142	7		42
105-.....			15	A.O.R.		129

<i>Flare-ups.</i>						
Day.....	3	4	5	6	7	8
	40	28	48	22	8	6

Most of these subsided within three days. Those not subsiding were treated surgically. over half of all cases will show a normal temperature. At the end of forty-eight hours three of every four will be normal. Temperature flare-ups, however, are not uncommon but usually subside within three days. On the other hand, patients may have considerable pain—enough to keep them awake nights—without temperature. These cases we deem operative and a surprising number show gross evidence of early abscess formation. It is for this reason that pain sufficient to keep the patient awake the second night is our criterion for performing epididymotomy in those cases not grossly suppurating.

Quite aside from the operative risk it has been urged by many that surgi-

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cal interference entails sterility of the involved organ. Later observations on cases having bilateral operation seem to have dispelled this feeling and a statistical study of results obtained show that sterility after operation is certainly no greater than without operation and some⁸ present data to prove aspermia is less frequent following epididymotomy. Surely sterility is no greater with operation and the attendant discomfort and danger of such secondary complications as suppuration and subsequent loss of the testicle are minimized by early opening when indicated.

Acute pain in some of these patients has been relieved by subcutaneous puncture of the epididymis. Although quite satisfactory, it is a blind surgical procedure, palliative in many cases (some have required open epididymotomy later) and is not recommended for general use. Open epididymotomy by the method of Hagner⁶ is the procedure of choice. It is relatively simple, effectual, does not incapacitate the patient for long and will save not only many epididymes from suppuration but not a few testicles from secondary involvement.

Briefly this method of epididymotomy consists in the exposure, delivery and multiple puncture of the involved epididymis. (Fig. 5.) A Hagedorn

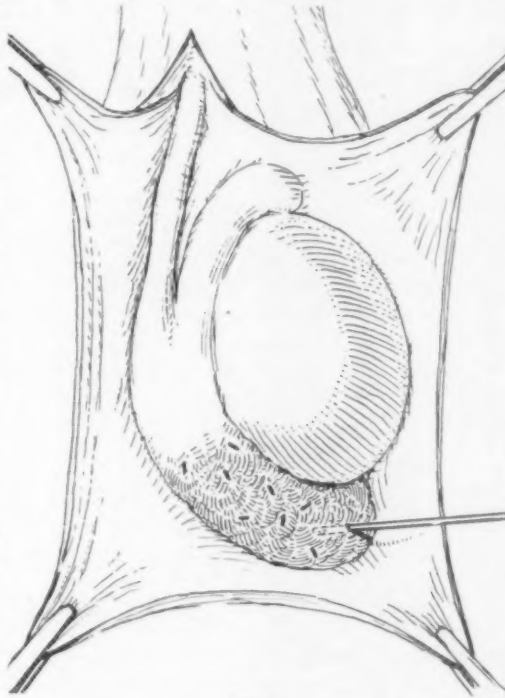


FIG. 5.

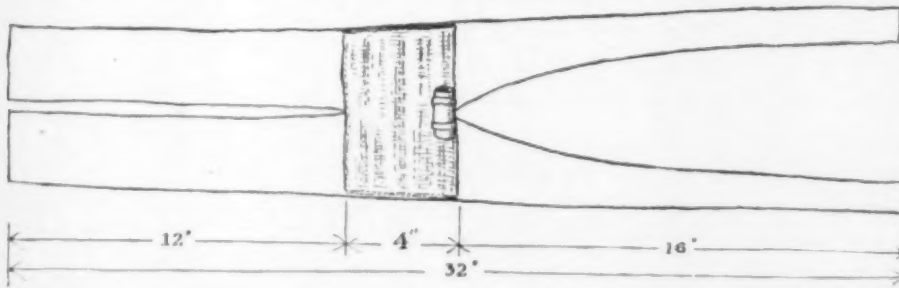


FIG. 6.

needle serves admirably for making the punctures. Relief is afforded by relaxation of capsular tension about the organ with liberation of a certain amount of serous fluid. Droplets of free pus are often encountered and a

small incision into such punctate abscesses is advised. Following puncture, the organ is replaced in the scrotum and the incision closed with a small cigarette drain at the lower angle. The scrotal hæmostatic compression bandage also devised on the Urological Service at Bellevue is then applied.⁴

Essentially a four-tailed adhesive bandage of construction and dimensions indicated in Fig. 6, and fitted with a roller which is placed snugly high in the scrotal-perineal angle (Fig. 7) the lower straps are fastened to the

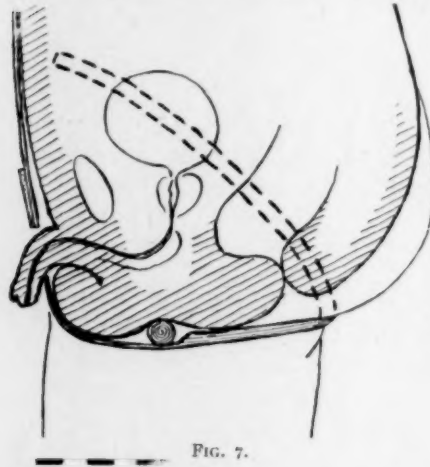


FIG. 7.

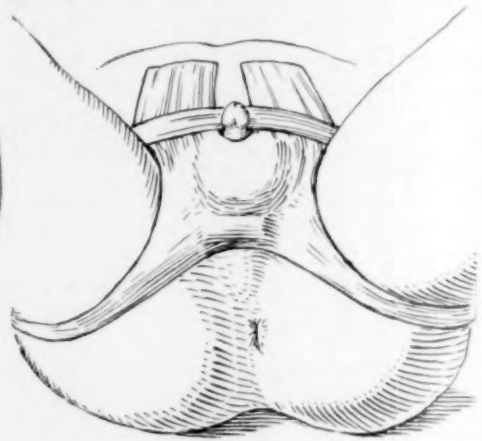


FIG. 8.

skin through the gluteal folds and brought around over the hips. (Fig. 8.) The upper wider straps are brought up over the anterior abdominal wall, hemming in the scrotal contents firmly on each side. (Fig. 9.) An additional cross suprapubic strapping lends support and adds materially to the compression brought upon the scrotum. This dressing has practically eliminated post-operative scrotal bleeding at once so distressing and at times alarming and so frequently occurring in the loose tissues of the scrotum.

Post-operative care requires but the removal of the cigarette drain after twenty-four hours and the removal of the sutures on the fifth day. Most of these patients are sent home on the sixth day, the average period of hospital residence in uncomplicated surgical cases being 7.5 days, of all our cases 3.8 days as shown in Table XV.

TABLE XV.
Period of Hospitalization

Days	Non-surgical	Days	Surgical
1.....	321	2.....	2 (A.O.R.)*
2.....	528	3.....	1 (A.O.R.)
3.....	673	4.....	7 (A.O.R.)
4.....	482	5.....	21
5.....	310	6.....	91
6.....	117	7.....	41
7.....	135	8-13.....	35
Over 7.....	225	Over 2 weeks†.....	11
Average.....	3.8 days.	Average.....	7.5 days.

*A.O.R. Left Hospital. "At Own Risk."

†Longest hospitalization 49 days. This patient had an epididymotomy followed by epididymectomy with subsequent infection and orchidectomy.

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Complications.—Scrotal infections—superficial and deep—frequently follow operation. The former cause no distress, the latter sometimes involve the testicle with abscess formation, necessitating orchidectomy as occurred eight times in this series. Thrombosis of the cord secondary to collateral inflammation occurred four times with gangrene of the testicle.

Recurrence after epididymotomy is a comparative rarity and in these cases epididymectomy is usually indicated, particularly when the symptoms are severe. (Table XVI.) Many patients have multiple recurrent attacks of subacute type, the pain lasting but a few hours. These are best left alone. We did repeated epididymotomies twice in this series and epididymectomy three times for recurrence following primary epididymotomy. For recurrent epididymitis without operation epididymectomy was done six times. In private practice and with a more intelligent class of patients one would be less liberal in doing epididymectomy for recurrent attacks.



FIG. 9.

The only cure of post-epididymitis sterility lies in operation. An epididymotomy by the method of Martin has helped in some cases. None of our cases has been so treated.

TABLE XVI.

<i>Re-operation</i>	<i>Complications.</i>
Following epididymotomy:	
Epididymectomy.....	3
Orchidectomy.....	5
Epididymotomy repeated.....	2
Scrotal abscess (infected hæmatocele?).....	5
Following epididymectomy:	
Orchidectomy.....	1
Abscess of Vas (Incision and drainage).....	2
Pain:	
First operation partial epididymectomy. Second operation, total epididymectomy. Pain still persists.....	1

Subsequent Treatment.—During the acute period of the inflammatory process all local urethral treatment must be stopped. Rarely is it wise to

resume this until a month has elapsed, although sometimes we institute treatment by the third week. It must be done with greatest caution and gentleness as acute flare-ups are not infrequent following resumption of urethral injections. Instruments must be withheld from the urethra for a much longer period. Prostatic massage is attempted with considerable trepidation until at least six weeks have elapsed. Therefore, equally great care and skill must be exhibited in the subsequent treatment of the epididymitis patient as in the original attack since recurrences from ill-usage are frequent.

Acceleration of resolution and resorption of the exudate is best achieved by the use of the adhesive suspensory for at least ten days after the patient leaves his bed. Palpable post-inflammatory infiltration of the epididymis persists for at least six months after the acute attack, not infrequently for life.

In conclusion then, gonorrhœal epididymitis is a pandemic disease of early adult life occurring with slightly greater frequency on the right side, approximately one in fifteen are bilateral, and approximately the same percentage require operation. Rest in bed, splinting of the scrotal contents by the adhesive suspensory described and the application of an ice cap—all without urethral treatment—constitutes the best method yet devised for the non-surgical treatment of this condition. Epididymotomy affords immediate relief from pain and, in the average case, hospitalizes the patient but 3.7 days longer than non-surgical treatment.

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TUBERCULOSIS OF THE KIDNEY IN PREGNANCY*

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A REVIEW of the literature shows us that cases of tuberculosis of the kidney associated with pregnancy are so seldom reported as to be regarded as rare. Owing to the lack of systematic grouping and classification of cases in which this lesion is associated with pregnancy, it is difficult to determine the frequency with which it occurs. James Israel and W. E. Stevens each report two cases, no other authors having reported more than one. In 3103 patients at the Stanford Clinic only one case was found. Some writers believe that there is a natural resistance of pregnant women to tuberculosis. The contrary is, however true, pregnancy is more than likely, as a result of increased physiological activity to light up any old focus of tuberculosis.

In a careful survey of the records of an institution with a large maternity service, 6000 consecutive records show not one case diagnosed in pregnancy—note the word diagnosed, it is highly significant.

In attempting to judge the frequency of these cases, Werboff emphasizes the necessity of remembering cases in which interruption of pregnancy was undertaken owing to renal symptoms. The real causes of these cases are often undetermined. It being a fact that renal tuberculosis is more common in women; would it not seem natural to accept the theory that exacerbations are caused by pregnancy.

In all renal affections of pregnancy the right kidney is most often affected. This is also true of renal tuberculosis.

Symptoms.—The peculiarities of symptomatology in renal tuberculosis during pregnancy are largely due to the changes in the urinary passages during this period. In the majority of pregnant women suffering from this disease, the first symptom is pollakiuria usually of the painful type. Undue frequency of urination is not uncommon in normal gestation. It is, however, usually painless and diurnal. In the tuberculosis of the kidney in pregnancy it is both day and nightly.

Pyuria is so often associated with other diseases that in itself it has little significance in diagnosis. Hæmaturia is a fairly frequent occurrence and is often one of the first symptoms noted. It must, however, be distinguished from the hemorrhages of the bladder and urethra frequently seen in pregnancy. A few authors speak of violent renal pains during the course of the disease. In one of Israel's cases renal colic was noted during the first weeks of pregnancy. In this case interruption of the pregnancy resulted in making the intervals between the attacks more prolonged. Fever as a symptom is present to a greater degree and with greater constancy than in ordinary renal

* Read before the Southeastern Clinical Society of New York, May 10, 1927.

tuberculosis. The temperature often runs around 40° F. and is hectic in nature. Small quantities of albumin so characteristic of renal tuberculosis appear frequently, particularly in the latter months.

The most important finding is of course the tubercle bacillus. Some investigators believe that the organism is found in 100 per cent. of their cases. Others (and this is more likely) have found it in only 20 to 25 per cent. But even the finding of the tubercle bacilli does not clinch the diagnosis, as bacilli may also be found in excreting tuberculosis and in the so-called tubercular nephritis.

Gratke reports a case in which the presence of leucocytes, erythrocytes and tuberculosis in the urine was made the basis of a diagnosis. Excision of the kidney revealed no evidence of tuberculosis. The tuberculin test is not of very great value in this particular lesion. This is because of a greatly reduced sensibility of the pregnant to tuberculin.

A very important procedure in these cases is vaginal palpation of the ureters. This is a field which has been so well discussed by A. M. Judd. Investigation in this way will usually locate the diseased side. An increased irritability of the corresponding ureter is usually present in the very early stages, and before any bladder changes have developed. It has been said that the ureters are sensitive in an ordinary pregnancy. This is true but they are not painfully so. We must also study this symptom in the differential diagnosis of stone.

Renal function tests may be dismissed as of little value as these are so commonly affected by ordinary pregnancy.

Cystoscopy and ureteral catheterization are not contra-indicated during pregnancy except perhaps just before delivery. Even this is doubtful. We believe that these extremely valuable procedures should never be neglected. Failure to use them probably accounts for many undiagnosed cases of the disease under consideration. Ureteral catheterization and pyelography gives us the only certain information regarding the condition of the kidneys.

Diagnosis.—In diagnosis the following diseases must be considered. Acute pyelitis—this usually does not appear until the latter half of pregnancy. Renal tuberculosis usually manifests itself very early. Pyonephritis, renal calculi, glomerulonephritis and tumors can all be ruled out by a careful complete urological examination.

Treatment.—In reference to treatment, the physician has three courses open to him: (a) Palliative. (b) Conservative. (c) Radical.

In the conservative treatment one merely adopts an expectant attitude giving symptomatic treatment until the end of pregnancy, a method only to be adopted where no competent assistance is at hand.

The palliative treatment consists in the emptying of the uterus in order to do away with the injurious effect of pregnancy on the tuberculous process.

Radical treatment consists in nephrectomy or a combination of abortion and nephrectomy. Removal of the kidney is certainly the method of choice

TUBERCULOSIS OF THE KIDNEY IN PREGNANCY

in unilateral renal tuberculosis. The conservative measures should be reserved for bilateral affections or for tuberculosis of a remaining kidney.

Mirabeau believes these indications hold good in both the pregnant and non-pregnant. A review of the literature shows that in 69 per cent. of cases in which exacerbation of unilateral tuberculosis occurred during pregnancy, abortion or nephrectomy became immediately necessary. Thus it would seem that pregnancy instead of increasing the necessity for conservative treatment of renal tuberculosis would contra-indicate it. As the renal process is acutely exacerbated in 71.1 per cent. of the cases immediate intervention is urged. Certainly interruption of pregnancy does not stop the tuberculosis process, and this procedure is particularly dangerous during the latter months. After careful consideration and an extensive experience in the renal affections of pregnancy we unhesitatingly recommend nephrectomy in these cases of tubercular infection. We have examined the records of thirteen cases in which nephrectomy was performed by others. In this group of cases eight resulted in an uninterrupted pregnancy and delivery at full term. In four, abortion had to be resorted to after the nephrectomy. The remaining case is vague. Of the three cases we have observed, two went to full term following nephrectomy. The third was aborted at the fourth month, the patient dying one month later. If good results are to be expected from nephrectomy the opposite kidney should be normal. A suspicion of bilateral involvement is a distinct contra-indication for surgical removal of the kidney. We do not believe that pulmonary tuberculosis is an indication to abstain from surgery, unless the process in the lungs predominates. Each case, however, is a law into itself.

As to nephrectomy and abortion. We do not believe this combination is justified, as some advocate. We believe the latter only permissible where the patient refuses nephrectomy or when an infection of the remaining kidney is found following nephrectomy. As to future pregnancies, we believe their avoidance is eminently proper.

Tuberculosis and the Child.—The result of the tuberculous infection on the course of pregnancy and on the child in a series of four cases not operated upon was as follows:

Abortion occurred in two cases, one child was infected at birth and subsequently died of tuberculosis, one normal child was delivered at term. This certainly demonstrates the advantage to both mother and child of immediate nephrectomy.

Results of Nephrectomy.—From the cases collected by Stevens the conclusion may well be drawn that pregnant women stand the operation particularly well. It is apparently no more serious than when attempted in the non-gravid state. Following the removal of a kidney as here considered, Stevens urges that tuberculin be administered, the urine examined for a considerable period of time and the patient kept under observation. This is scientific urology and certainly needs no comment.

WINFIELD SCOTT PUGH

CASE I.—M. L., white, age twenty-six, native of Poland. Present complaint: Pollakiuria, nocturnal and diurnal. Four months pregnant. Family history: No record of tuberculosis.

Previous personal: Measles and scarlatina in childhood. Rheumatism at eighteen. Several attacks of bronchitis during the past few years. One normal childbirth three years ago.

Present illness: Patient has noticed for the past two months a gradual increase in the frequency of urination. She has not bothered very much about this until the last two weeks. Since this time the frequency is day and night and quite painful. There is also slight pain at times over the right renal area, radiating down along the course of the ureter. At this point she was referred to us.

Examination shows a rather delicate looking woman apparently about four months advanced in gestation. An examination of her heart and lungs made by Dr. S. Lloyd revealed no apparent tubercular lesion. Abdominal palpation reveals aside from the pregnant uterus, a distinctly enlarged and painful kidney. Catheterized specimen of urine shows much pus, but no apparent tubercle bacilli. A complete urological examination was decided upon. The report follows:

Cystoscope enters bladder readily with but little pain. On filling the bladder considerable irritability was noticed when the viscus contained over 100 c.c. The important feature in the bladder was a slight ulceration just below the right ureteral orifice. Marked tent-like retraction was noted in the right ureter. Catheters pass readily to both pelves. Specimens taken show the following:

Right kidney	Left kidney
Color—very cloudy	Clear
Urea—trace	1¼%
P. S. P.—trace in 15 mis.	3 mis.
Pus—abundant	None
R. B. C.—a few	None
Albumin—considerable	None
T. B. C.—none	None

Guinea-pig inoculations from the right ureter were later positive.

It was considered unwise (by consultants) to do a pyelogram, as enough evidence was already available. Nephrectomy was performed with a great improvement in patient's condition and she went on to a full-term delivery.

CASE II.—Mrs. McD. (Patient of Doctor McGivern.) White, age thirty-one, native of Ireland. Present complaint: Urgency and frequency in urination, about five months' pregnant.

Family history: Mother and one brother died of a pulmonary, disease probably tuberculosis. Previous personal: Bronchitis, pertussis and pneumonia during infancy.

Two previous maternities. History otherwise negative.

Present illness: Patient states that about two months ago a pollakiuria appeared at first only during the day, but that recently it also annoys her at night. Urination has become painful and urgent. Pain has appeared over the right kidney. Her physician has examined her carefully for tuberculosis of the lungs and has also had the urine examined repeatedly, and it is always negative for tubercle bacilli.

A complete urological examination was made. This revealed marked contraction of the bladder and pus coming from the right ureter. The pus contained tubercle bacilli. No response to functional test of right kidney. Pyelogram showed the typical moth-eaten kidney so often seen in renal tuberculosis. Vaginal examination revealed a markedly swollen and painful ureter on the right side. Diagnosis of renal tuberculosis. Operation of nephrectomy was performed about two weeks later. Convalescence was uneventful. Labor occurred at about eight months. The child is apparently healthy.

TUBERCULOSIS OF THE KIDNEY IN PREGNANCY

CASE III.—Mrs. L. W., white, age twenty-five, native of U. S. Patient of Doctor Yacobin. Present complaint: Pain in right lumbar region and frequency of urination.

Family history: One brother said to have died in childhood of pulmonary tuberculosis.

Previous personal history: Has had the usual diseases of childhood—mumps, measles, etc. One attack of acute rheumatic fever at eighteen. Otherwise always well.

Present illness: Patient believes that her condition began about seven months ago, that is three months prior to impregnation. At first she noticed a dull ache at times over the renal area. These aches gradually increased until they became attacks of renal colic. Attacks have been much more frequent since conception and a marked pollakiuria has appeared.

The usual urological examination was carried out and the right kidney found well advanced in tuberculosis.

Treatment: We recommended that she have an immediate nephrectomy. This was not agreed to by the family or the physician to the household and as we refused anything else, the case passed out of our hands. The patient was then treated by a well-known obstetrician, who emptied the uterus. Two weeks later the patient died of a lesion said to be pneumonia.

SUMMARY

We believe that these cases and those previously reported by others justify the claim that nephrectomy is the procedure of choice, in unilateral renal tuberculosis of pregnancy.

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THE PATHOLOGY OF CHARCOT JOINTS*

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CHARCOT, or neuropathic joints, present variable pathological pictures, depending upon the time of observation. Because of the painless onset, the condition is rarely seen before marked bone and joint pathology exist.



FIG. 1.—(Case I.) Charcot shoulder with sclerosis of the head of the humerus. Six weeks old fracture of the humerus.

Atrophic and hypertrophic changes in the articulating bones are described; one writer claiming atrophy, another hypertrophy as the predominating pathological change. As a result, two kinds of arthropathy have been thought to exist. It is believed that this variation depends only upon the time of observation, and that all uncomplicated Charcot joints go through a definite and similar process of change in this order: loss of protective joint sensibility; relaxation of the lateral ligaments with

consequent minor marginal and major joint fractures; destruction of the articular cartilage and the intra-articular ligaments; sclerosis of the bone ends denuded of cartilage; peri-articular and par-osteal bone production; continued erosion and fracture of the articulating ends; and finally, when the bones no longer articulate, or when invalidism occurs, atrophy. The process may stop at any point, or any of the above characteristics may predominate or be subordinated depending upon the joint involved and the extent of the nerve injury.

Pathogenesis.—In the light of our present knowledge the pathogenesis seems clear. The original theory of Charcot that neuro-arthropathy is due

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FIG. 2.—(Cas. I.) Charcot spine.

primarily to a change in the central nervous system is still generally accepted. If the two cases of Charcot joints following peripheral nerve injury reported by Philips and Rosenheck¹ prove after sufficiently long observation to be such, the theory will have to be extended to include also lesions of the peripheral nerves. Any joint deprived of its sensory mechanism and subject to trauma may become a typical Charcot joint. Arthropathies have been reported following stab wounds of the back, brachial plexus injuries, transverse myelitis, spina bifida, and amyotrophic lateral sclerosis. Most of the

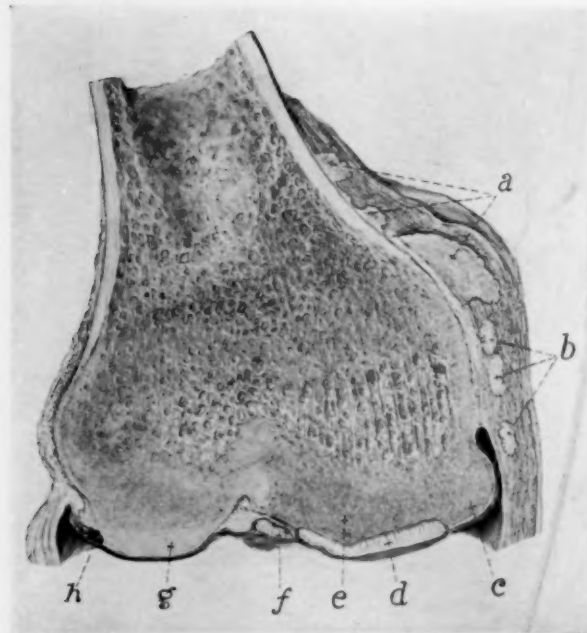


FIG. 3.—(Case II.) (a) Par-osteal bone; (b) bone plaques in the capsule; (c) peri-articular bone; (d) articular cartilage preserved; (e) normal bone; (f) remnant of cruciate ligament; (g) sclerotic bone; (h) marginal fracture.

cases, however, are seen in tabes and syringomyelia; approximately 10 per cent. of tabetics and 25 per cent. of syringomyelitics developing typical joint changes. (Borchard².) There is no reason why Charcot joints cannot develop as well following a peripheral sensory as a central sensory nerve lesion, provided the motor power of the member has not been involved. Eloesser³ proved trauma an essential factor. He cut the posterior sensory nerve roots to one leg in a number of cats. None of the animals showed joint changes. Trauma to the densitized joints resulted in the development of typical arthropathies in every animal experimented upon. In the course of recent experiments requiring the desensitization of a limb (work to be reported later), I cut the posterior sensory nerve roots to one hind leg in eighteen dogs. No gross joint changes followed. The body weight of the animal distributed to four extremities lessens the strain on the desensitized joint. Trauma does not occur, and arthropathies do not develop. That trauma is an essential factor is suggested by the greater frequency of tabetic joints in the pre-ataxic stage. Likely in these cases the first change is in the sensory nerves to the joint. Normal movement is not interfered with, and the joint surfaces are subjected to greater strains than in the ataxic stage.

It is believed that in a true flaccid paralysis arthropathy does not develop because one of the essential factors is missing—the necessary muscle power to manipulate the joint and bring the articulating bones into forceful apposi-

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tion. However, Mme. Dejerine⁴ found thirty-eight instances of para-osteoarthropathy in fifty-eight cases of paraplegia. The authors think this condition does not occur in cases of destruction of the gray cells below the site of injury. They ascribe the new bone growth to an irritability of the nerve cells of the intermediate gray column in the segments of the dorsal cord below the injury, and to irritation from involuntary movement.

The apparent paradox of pain in an insensitive joint has caused some to question whether the sensory nerve lesion is essential. Oehlecker,⁵ and more recently Eloesser⁶ demonstrated by thrusting a pin through the sensitive soft tissues into the joint that its surfaces and the periosteum about the joint are insensitive. The pain caused by effusions into the joint is due to the distention of the soft tissues.

Gross Pathology.—

Relaxation from tear of the lateral ligaments is the first grossly recognizable change. It is manifested clinically by an increased lateral mobility of the joint. This results in joint injury. Contusions, loosening of osteophytes, and marginal fractures, especially in the lower limbs, often with effusions, follow.

Villous formations of vascular character grow on the inner margin of the capsule and in the intercondylar spaces. If a fracture occurs through these villi, or if they are severely contused, hemorrhagic effusion results. The small detached fragments, microscopic or gross, remain in the joint or lodge in the capsule and the surrounding ligaments where they grow and form the loose bodies in the joint and the bone islands about the joint characteristic of neuro-arthropathy.

Peri-articular bone formations in the early stages present a picture identical with that of hypertrophic osteo-arthritis. As the process advances these masses become larger and more irregular than in arthritis, and extend on the shaft for a cm. to 10 cm. or more. This parosteal bone is pathognomonic of a Charcot joint. It may grow into the ligaments and extend into



FIG. 4.—(Case II.) Charcot knee and hip. (a) Sectioned tibia; (b) condyles of the femur; (c) articulating surface of the patella; (d) anterior surface of the upper end of the tibia; (e) changes in an early Charcot hip (see text).

the muscle resembling myositis ossificans, with this difference, that myositis ossificans is rarely connected with the joint except in elbow injuries. (Machol⁷) The haphazard arrangement of this bone suggests that it grows in response to continued irritation.

Intra-articular destruction begins early and continues as long as the patient lives. The cruciate ligaments and the semi-lunar cartilages in the knee and the teres ligament in the hip are destroyed. The articular cartilage is slowly and painlessly worn away, usually first on the distal surface. As long as it remains intact there is no gross change in the underlying bone, but as soon as the bone is exposed sclerosis occurs. This hardening process can be observed at some time in the development of all ordinary Charcot joints. It is not a part of the disease but rather a local, protective bone reaction.

It is claimed that the shoulder and hip-joints usually show atrophic changes only. I believe they go through the same process as any other joint. Because of the construction of the hip and its great liability to fracture of the neck when densensitized, these cases usually come under observation when fracture occurs, before marked joint pathology exists, or late, when function is interfered with due to absorption of the head and to extensive joint disorganization. In the affected shoulder-joint relaxation of the ligaments allows the head of the humerus to fall far from the glenoid fossa. Atrophy from lack of articulation and lessened use follows.

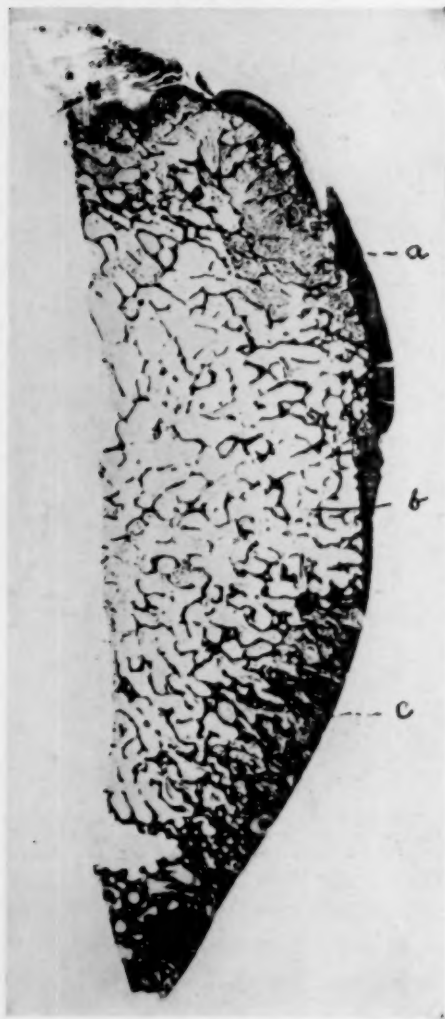


FIG. 5.—(Case I.) Section from the head of the humerus. (a) Articular cartilage preserved; (b) replacement of marrow by fat; (c) articular cartilage worn away, bone sclerotic.

CASE I.—C. W., age seventy-one, with tabetic paraplegia for twenty-two years, entered the Presbyterian Hospital on Doctor Phemister's service with a recent traumatic fracture of the right humerus, and Charcot joints of the right shoulder and spine. Six weeks after placing the fractured humerus in a plaster case the patient died of pyelo-nephritis secondary to bladder incontinence and overflow. The right humerus and the entire spinal column were removed for study.

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Where the articular cartilage of the head of the humerus is worn away over an area 5 cm. in diameter, the bone is smooth and eburnated. Longitudinal section shows this sclerosis, of uniform density, to extend about 1 cm. into the bone. About the denuded area the cartilage increases from paper thickness to normal at the periphery. It is irregular, pitted, and nodular. At the margin there is lipping osteo-arthritic in character. Anterior to the intertubercular sulcus lies an area of par-osteal bone, 2 by 3 cm., and $\frac{1}{2}$ cm. thick. (Fig. 1.)

The fractured humerus illustrates the same changes seen in the joints. There is sclerosis of the ends of the fragments, and an extensive overgrowth of cartilage. The fracture was painless, the patient very unruly, and consequently a great deal of irritation of the fragments resulted from movement in fixation appliance. Excessive callous formation in five weeks in a man seventy-one years old emphasizes the value of mobilization in callous formation. (Fig. 1.)

In the spine there is marked arthropathy between the first and second and the second and third lumbar vertebræ. The inter-articular cartilage is from 1 to 3 mm. thick, and in some areas is entirely gone. Sclerosis of the apposing surfaces is marked. Proliferative arthritis at the margins is extensive, and has resulted in bony bridging. The body of the second vertebra is slightly compressed. No loose bodies about the joint. There is no impingement on the spinal canal. (Fig. 2.)



FIG. 6A.—(Case III.) Intra-articular fracture of the medial tuberosity of the tibia.

The knee is the most common site of neuro-arthropathy. The following case is typical :

CASE II.—Mrs. R. M., age forty-three, had swelling of the right knee and painless grating in the joint for three years. She entered the Presbyterian Hospital on Doctor Gatewood's service in semi-comatose condition. A perforating ulcer of the right great toe had become infected and resulted in septicæmia. She died three days after admission. At autopsy the right tibia and femur were removed for study.

The changes are characteristic of a moderately advanced Charcot knee. The capsule is greatly stretched, thickened, and contains many bone plaques. Erosion of the articular cartilage of the lateral condyle of the femur due to weight bearing in an extreme valgus position has resulted in eburnation of the denuded bone. The bone

beneath the irregular but intact articular cartilage of the medial condyle shows no gross change. There is extensive peri-articular bone formation along the margin of the medial condyle. Par-osteal bone 1 cm. thick extends up the medial surface of the shaft of the femur 6 cm. (Fig. 3.)

The cruciate ligaments and the semilunar cartilages are entirely destroyed. The medial tuberosity of the tibia is on a plane 2 cm. lower than the lateral, which has been worn down. Its margin is free of cartilage, and sclerotic. In the fossa the cartilage is preserved. The upper surface of the lateral condyle with no cartilaginous

covering consists of sclerotic bone. The joint surfaces of the patella show similar changes. Peri-articular bone in large masses extends irregularly from the margins of the patella and both condyles. (Fig. 4.)

Although this patient complained of no trouble in her hip, it shows the earliest changes of neuro-arthritis. The capsule is thickened. At the articular margin of the head there is lipping, jagged in places where marginal fractures have occurred. Plaques of bone from 1 to 2 mm. in diameter are attached to the neck of the femur, all within the capsule. The teres ligament is in shreds. The articular cartilage is worn down, and at the point of weight bearing over an area $\frac{1}{2}$ cm. in diameter, is worn away. In this small area the underlying bone is already sclerotic. (Fig. 4.)



FIG. 6B.—(Case III.) Same as 6A six months later. Complete separation of fragment.

picture is that of repair of irritated and broken tissue. The capsule consists of fibrous tissue in which at times are embedded islands of bone and cartilage. The bone is of cancellous structure; the cartilage, hyaline. Deposits of calcium salts may lie in the scar tissue about the fragments. (Kawamura.⁸)

The peri-articular and par-osteal bone attached to the cortex and the periosteum invades irregularly the surrounding fibrous tissue. Areas of ossifying cartilage are scattered in this bone. Lymphoid cell nests resembling bone-marrow are present where the bone is thick. In places there is ossification of the fibrous tissue replacing the tendons and muscles. (Barth⁹.)

The synovia is thickened. Serous or sero-hemorrhagic fluid is commonly

Microscopic Pathology.—The microscopic

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found in the joint. Villous formations attached to the inner surface of the capsule and the intercondylar spaces consist of loose vascular connective tissue and fat. The walls of the vessels are thickened, and some are thrombosed. Where articulation occurs poorly the cartilage is very irregular and permeated with fibrous tissue. In the bone ends where the cartilage is not destroyed the marrow is partly replaced by fat. Areas of bone absorption occur. The haversian canals are widened. Where the cartilage is worn away



FIG. 7.—(Case IV.) Bilateral Charcot hips.

the bone is greatly increased in density. The interstices between the bone formations are small and filled with fibrous tissue. (Fig. 5.)

X-ray Pathology.—The röntgenographic findings are of prime importance as they illustrate the "pathology of the living."

The first deviations from normal are: increase in the joint space due to ligament relaxation and wearing down of the articular cartilage; roughening of the joint margins due to marginal fractures; and joint lipping. Occasionally, as is illustrated in the following case, an intra-articular fracture is the first evidence of neuro-arthritis.

CASE III.—J. B., age thirty-eight, came to the Central Free Dispensary complaining of a swollen, persistently painful left knee. Nine months previous while crossing the street he had twisted the knee. Immediate swelling and pain developed and persisted. He was treated as a case of mild arthritis. Examination revealed moderate swelling of

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the knee, tenderness and crepitus over the medial tuberosity of the tibia, slight resistance to flexion and extension, and excessive freedom of motion laterally. The X-ray discloses a complete fracture of the internal tuberosity of the tibia; moderate peri-articular bone formation; increase of the joint space; sclerosis of the upper end of the tibia. (Fig. 6A.)

The patient refused treatment. In six months he returned with marked advance in the process, but alleviation of all pain. (Fig. 6B.)

As process advances, sclerosis of bone ends denuded of cartilage appears in X-ray. Bony islands formed from loosened fragments appear in the joint

and its capsule. The peri-articular and par-osteal bone is pathognomonic of the process. As sensation in and about the joint lessens, and multiple fractures and erosions occur, complete disorganization follows, and the joint becomes literally a bag of bones. The atrophy which appears late is the atrophy of disuse.

That the sclerosis mentioned above occurs in upper extremity and hip arthropathy is illustrated in Fig. 1 and in the following cases:

CASE IV.—C. H., age forty-eight, tabetic, had had bilateral "hip trouble" requiring the aid of crutches for eight years. Seven months previous to examination by Doctor Bevan he had sustained an injury to the left elbow. Swelling, pain, and limitation of function persisted.

X-ray Examination.—The head, neck, and lesser trochanter of each femur is gone. The shafts are displaced upward to within one inch of the level of the anterior superior spines. In the right acetabulum there is a remnant of the head of the femur. Both femoral shafts and the acetabular region show marked atrophy. There is no par-osteal bone. (Fig. 7.)



FIG. 8.—(Case IV.) Charcot Elbow. Atrophy of non-articulating radius; sclerosis of articulating ulna.

In the elbow-joint there is destruction of the articular surfaces. Loose bodies in the joint and bony deposits in the capsule are evident. The external condyle of the humerus, the head and neck of the radius are gone. Peri-articular and par-osteal bone on the lower end of the humerus and upper end of the ulna are marked. Atrophy of the upper end of the radius which does not articulate, and sclerosis of the ulna which does articulate. (Fig. 8.)

CASE V.—F. B., age thirty, fell while attempting to board a car, and sustained an injury to his hip. Severe pain and complete loss of function resulted. When seen three days later, local examination revealed 1 cm. shortening of the thigh, and moderate tenderness in the hip on pressure and motion.

X-ray examination discloses narrowing of the joint space superiorly, widening medially; flattening of the head of the femur; sclerosis of the head and the region about

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FIG. 9.—(Case V) Stage of sclerosis in early Charcot hip.



FIG. 10.—(Case VI) Charcot shoulder in syringomyelic.

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the acetabulum; bone production and bone destruction; granular debris in the joint. (Fig. 9.)

CASE VI.—V. S., age fifty-three, laborer, with syringomyelia, presented himself with trophic ulcers of the right chest wall and an advanced right Charcot shoulder. His occupation, that of hide scraper, resulted in a great deal of irritation of the shoulder with consequent extensive overgrowth of bone. (Fig. 10.) The upper one-third of the humerus is gone but the remnant, still articulating, is sclerotic.

We have illustrated in Case IV the stage of atrophy from lack of articulation; in Cases V and VI the stage of sclerosis and hypertrophy. The elbow-joint in Case V illustrates both conditions in the same joint.

Discussion.—Neuro-arthropathy may affect any joint in the body. Two conditions must obtain: a change in the sensory nerves of, and trauma to, the joint. As long as the existence of trophic nerves is unproven there is no reason to believe this condition due to anything but the destruction that must follow in a joint without its protective sensory mechanism. When the bones are deprived of the accurate weight distributing power of the muscles and of the stabilizing protection afforded by an intact reflex nervous mechanism minor stresses will result in damage. So-called spontaneous fractures in tabetics are common for this reason.

On this hypothesis neutrophic joints are simply changing pictures of destruction and erosion and nature's attempt to stop the damage by sclerosis and repair the damage by building up new bone. The bizarre pictures are the result of the excessive rapidity of either process.

Modifying terms, if any, should be those descriptive of the predominating process.

This study was made at the suggestion of Doctor Phemister to whom I am indebted.

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THE PREPARATION OF COLLOIDAL LEAD FOR THERAPEUTIC USE*

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THE present paper presents a technic for the preparation of colloidal lead which is based upon Bredig's¹ method for the preparation of colloidal metals. This technic has been used in the preparation of colloidal lead intended for intravenous injection in this hospital. In Bredig's method two metal electrodes are immersed in water or some electrolyte solution. A current is then passed through the electrodes, which are held just far enough apart so that an electric arc is formed between them. The arc disintegrates the metal of the electrodes which disperses in the liquid to form a more or less stable colloid. The stability of the colloid formed depends upon the condition of the experiment and the metal used. Colloids of a number of different metals may be made in this way.

Apparatus.—The apparatus, illustrated in the accompanying figure (Fig. 1) consists essentially of a lead plate as anode, and an adjustable roll of lead foil as kathode. The holder for the kathode is a modification of the Columbia arcing stand described by Beans and Eastlack.² "L" is a hard rubber block carrying the contact plug "A", and the screw feed "E". From "A" connection is made through the sliding contact "C" with the brass tube "D", which may be fed down slowly by means of the screw feed "E". The whole electrode holder may be fastened to a stand by means of the clamp "G". The electrode "F" is a roll of C. P. lead foil which is inserted in the tube "D" and fastened there by means of the small screw "P".

The positive electrode is the lead plate "I", having a strip of lead leading to the top of the beaker "H", and a rounded portion of such a size as to cover the bottom of the beaker. The beaker is covered with a mica cover "M", which is perforated to admit the passage of the kathode and of the glass tube "J" and the thermometer "K". The beaker is immersed in a water bath with an outlet (not shown in the figure), so that the temperature of the sol may be kept low during arcing.

The electrodes described are connected in series with an ammeter and one or more rheostats to a 120 volt D. C. circuit. A voltmeter is connected in parallel with the arc. It is desirable that one of the resistances in the circuit should have a large self-inductance, as this aids in the maintenance of a steady arc. The lead used for the anode in this work was $\frac{1}{16}$ of an inch commercial sheet lead from the National Lead Co. That for the kathode was "Pueblo" lead foil, silver and bismuth free, from the American Smelting

*A complement to the paper by Stone and Craver, on The Colloid of Lead Treatment of Malignant Neoplasms in the ANNALS OF SURGERY, September, 1927.

and Refining Co. It was obtained in ribbons 8 cm. wide, weighing 1.2 gm. per linear cm. Sections of this ribbon were rolled lengthwise to form the electrode.

Method.—The electrolyte solution or the distilled water in which a sol is to be made is first boiled to expel the major portion of the carbon dioxide it contains. The beaker is immediately transferred to the water bath, and the anode and the mica cover are put in place. The thermometer is adjusted below the surface of the solution, and the end of the glass tube "J" just above the surface. A stream of air freed from carbon dioxide by washing with strong potassium hydroxide solution is passed through this tube and over the surface of the liquid during the entire time the apparatus is in use. A stream of cold water is allowed to flow through the water bath until the temperature of the contents of the beaker has fallen to about 40° C. After this the water is turned off and ice is added to the bath.

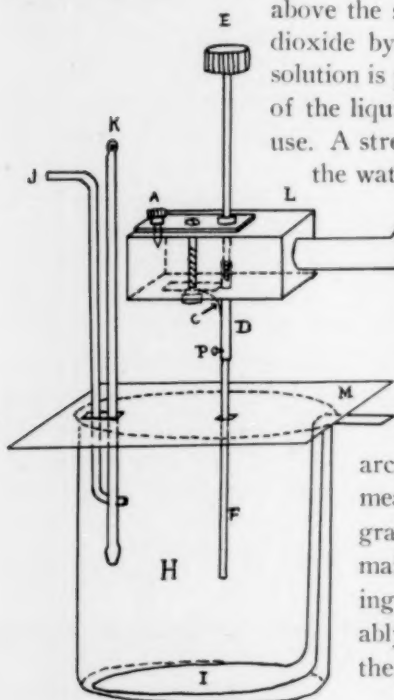


FIG. 1.

When the temperature of the liquid in the beaker has fallen to 20° C. the electric current is turned on and the cathode is slowly brought down to the anode until an arc forms. The cathode is then fed down by means of the screw feed as fast as it disintegrates, and with a little practice the arc may be maintained for several minutes without breaking. The anode does not disintegrate appreciably. If the temperature rises as high as 30° C. the arcing is discontinued until it falls again.

When the arcing has been continued for the desired total time, the circuit is broken and the lead sol is poured into 50 c.c. centrifuge tubes and covered with rubber caps. It is then centrifuged for five minutes at a velocity of 2450 R. P. M. in a centrifuge having a radius to the centre of the tubes of 15 cm. The force developed at the centre of the tubes is thus about 1000 x gravity. Samples are then withdrawn from the middle of the tubes for analysis, and melted paraffin is immediately poured over the surface of the sol so as to make a tight seal. It is important that no air bubbles be present under the seal.

The samples are analyzed by the colorimetric sulfide method this being checked occasionally against the specific gravity method of Stenstrom and Reinhard.³ In the colorimetric method a 0.5 c.c. to 2.0 c.c. sample of the sol is withdrawn by means of a pipette, the volume to be taken being determined by the apparent concentration of the sol. The sample is then diluted with water, dissolved by the addition of a drop of concentrated acetic acid, and made up

PREPARATION OF COLLOIDAL LEAD FOR THERAPEUTIC USE

to 25 c.c. in a quantitative flask. The solution is then transferred to a colorimeter cup and made slightly alkaline with ammonia. Two drops of 10 per cent. sodium sulfide are then added and the depth of color produced is compared colorimetrically with that formed in the same way from a standard lead acetate solution containing .005 per cent. lead. This method is accurate to ± 1.5 per cent. under favorable conditions, but as large errors occasionally occur, all sols intended for clinical use were analyzed in quadruplicate.

Properties.—Lead sols have been made by the method described with a number of different currents and electrolytes. Currents of 1.4 amp., 2.0 amps., 3.8 amps., and 7.0 amps, have been used. The electrolytes studied were .00025M HCl, .00125M H_2SO_4 , .00022M acetic acid, .00025M NaCl, .000125M $NaHCO_3$, .000125M Na_2CO_3 , .00011M KOH, .00022M KOH, and .00044M KOH. These solutions were all made up in water redistilled from permanganate solutions through a block tin condenser, and having a pH range of 5.2 to 6.0, with an average of 5.8. Lead sols were also made by arcing in distilled water to which no electrolyte had been added. There are not yet sufficient data to warrant definite conclusions regarding the properties of lead sols under these different conditions. In general, however, it may be said that the formation of colloidal lead sufficiently stable to withstand five minutes centrifuging with a force of 1000 x gravity is favored by a moderate (.00025M) electrolyte concentration and a high initial pH value of the solution in which the arcing takes place. The ions present also appear to exert a specific influence. Raising the amperage increases the concentration of the colloid produced, but also increases the technical difficulties. Sols made at 15°–25°C. are more concentrated than those made at 40°–50°C.

After arcing is begun in an electrolyte solution the concentration rises rapidly to a maximum which is reached after 1–1½ gms. of lead have been disintegrated per 100 c.c. of sol formed. After this the concentration of colloid which is stable to five minutes centrifuging at 1000 x gravity remains about the same even after prolonged arcing.

If the colloidal lead prepared under any of the conditions described is left exposed to the air it immediately begins to develop an area of clear supernatant liquid which increases rapidly. If the surface of the sol is large compared to its volume the entire sol may settle out in a few hours or days. If, however, the colloid is covered with a tight layer of paraffin as soon as it is made, the clear area does not develop, and the sol may be kept for from four to ten weeks with little change in concentration. Colloids so sealed have withstood six days' transportation by mail without differing appreciably from controls kept in the laboratory. It is important that air be excluded entirely, however, as 1 to 3 minutes vigorous shaking with air was sufficient to precipitate every sol so shaken. Shaking with carbon dioxide results in more rapid and complete precipitation than shaking with air.

As a result of the above observations the following technic was adopted for the preparation of colloidal lead intended for clinical use. An .088M solution of potassium hydroxide which had been standardized by titration

against a standard acid was diluted with distilled water to .00022M as required. The sols were made with aseptic precautions in this KOH solution with a current of 1.4 amps., the potential drop between the electrodes averaging 40 volts during arcing. The arcing was continued until $1\frac{1}{2}$ gms. of lead had been disintegrated from the kathode per 100 c.c. of sol formed, the temperature being kept between 15° and 25°C . by means of the ice bath. When the required weight of lead had been disintegrated, the sol was centrifuged, sampled for analysis, and sealed immediately with paraffin. Sols so prepared had an average concentration after being centrifuged for five minutes with a force of 1000 x gravity of .130 per cent. lead, with an average deviation of ± 11 per cent. of this value. They would keep for four weeks without coagulation or very great decrease in concentration, and withstood six days' transportation by mail. As the rate of decrease of concentration of sols which were standing quietly varied somewhat about an average value of 7 per cent. per week, sols which were kept as much as a week before use were reanalyzed. Care was taken not to include the sediment from centrifuging in portions of the sols which were intended for analysis or clinical use. There was little danger of this, however, as the sediment formed a very firm film on the bottoms of the centrifuge tubes. Sols ranging in age from two hours to nine days have been used for intravenous injection.

The sols could not be sterilized by boiling, as they precipitated when boiled. Hence those intended for clinical use were prepared with aseptic precautions. A series of six cultures from sols so prepared all proved to be negative. The colloidal lead itself appeared to possess some bacteriocidal properties, since of six cultures made from sols prepared with no aseptic precautions, only one was positive. †

These lead sols differ from those described by Blair Bell⁴ in being less concentrated, and in containing no gelatine or other protecting agent.

Summary.—An apparatus is described which is suitable for the preparation of colloidal lead by the Bredig method.

Colloidal lead has been prepared under a number of different conditions. Directions are given for the preparation of colloidal lead which is suitable for clinical use, and which is stable for several weeks.

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- ³ Stenstrom and Reinhard: *J. Bio. Chem.*, vol. lxix, No. 2, p. 607.
- ⁴ Bell: *Lancet*, 1926, vol. ccx, No. 1, p. 537.

† The author is indebted to Mr. E. B. Ellis of the Pathological Laboratory of this hospital for all bacteriological work.

TRANSACTIONS

OF THE

NEW YORK SURGICAL SOCIETY

Stated Meeting Held April 27, 1927

The Vice-president, DR. FRANK S. MATHEWS, in the Chair

ACUTE SUPPURATIVE APPENDICITIS COMPLICATIONS

DR. WALTER A. SHERWOOD presented a boy, nine years of age, to illustrate some of the various serious infective complications that may occur in the course of convalescence from suppurative appendicitis.

He was admitted to the Brooklyn Hospital, August 9, 1926, with the history and typical physical signs of acute appendiceal infection of five days' duration. There was a mass in the right iliac fossa, which indicated abscess formation. He was promptly taken to the operating room and the appendix removed through a right rectus incision. The organ was gangrenous. There was some free pus in right iliac fossa, and the organ was buried in a mass of dense omental adhesions. The appendix was ligated and removed without difficulty. A soft rubber tube was introduced into the pelvis. The patient made a good recovery from the operation.

There was nothing unusual about his convalescence until ten days later, when he complained of cramp-like pain in the lower left side of the abdomen. Temperature and pulse rate became elevated; there was an increased leucocytosis and abdominal and rectal examination indicated abscess formation low down on the left side of the pelvis.

On August 21, 1926, through a left rectus incision, the coils of intestine were found matted together. There was evidence of a localized peritonitis and in the depths of the pelvis a large abscess cavity was entered. A soft rubber drainage tube was placed in the pelvis and the remainder of the wound closed.

The patient convalesced normally for the following two weeks, when he developed pain and tenderness in the upper right quadrant of the abdomen. Temperature and pulse rate again became elevated, and there was every evidence of abscess formation in the sub-hepatic space. On the 18th of September, an incision was made just below the free border of the ribs. The peritoneal cavity was opened and a large abscess was found in the sub-hepatic space, from which about eight ounces of foul-smelling pus were evacuated. It might be mentioned here, that previous bacterial examination at the time of the original operation, revealed a long chain streptococcus. A soft rubber drainage tube was inserted in the abscess cavity, and wound closed in the usual manner.

From this time on, his convalescence was uninterrupted. All wounds healed kindly, and he was discharged from the hospital on October 14, 1926, two months after his admission.

Four days later he was again admitted to the hospital with all of the symptoms of acute high intestinal obstruction. His symptoms were cramp-like pain—generalized—over the abdomen, continuous vomiting, and obsti-

nate constipation. When admitted, his abdomen was somewhat distended. There was marked tenderness in the left upper quadrant and visible peristalsis. No masses were found and there was but slight muscular rigidity. A definite diagnosis of obstruction was made. He was again taken to the operating room and through a left upper rectus incision, a distended colon presented itself in the wound. Further examination revealed a collapsed ileum, and on following this, a definite firm band of peritoneal adhesions was found binding the ileum down in the pelvis. Above this band, the ileum was enormously distended. The band was divided, after which the distended coil collapsed, and the collapsed coil dilated. No other pathology was found, except the evidence of previous peritonitis, and the wound was closed in the usual manner without drainage.

Since this time, the patient's recovery has been without interruption, and he is now in perfect health.

DR. SEWARD ERDMAN said that all surgeons have seen many interesting variations in the complications of appendicitis and he thought that it might be of value at this time to refer again to a method of draining the residual pelvic abscess which he knew was not looked upon with entire approval by surgeons in general. In Doctor Erdman's own experience drainage through the rectum has been done in twelve to fifteen cases with entirely satisfactory results, especially in males, in which cul-de-sac drainage is impossible. It is very simple, does not produce shock, does not require opening the peritoneal cavity, does not increase the possibility of later adhesions, and often tides over the danger period for the patient who is rapidly going down hill. There is no abdominal wound to heal, and the patient may be allowed out of bed promptly. There can be no question but that this is a really valuable procedure in appropriate cases.

PERFORATING ULCER OF THE STOMACH INVOLVING PANCREAS

DR. WALTER A. SHERWOOD presented a colored man, fifty-six years of age, who entered the Brooklyn Hospital, September 10, 1926. His chief complaints were abdominal pain, indigestion, intermittent vomiting and constipation. He gave a history of "stomach trouble" extending over a period of many years. He belched large quantities of gas and had occasional attacks of vomiting. Two years previous to admission, he had a severe attack of pain in the right lower abdominal quadrant, which was relieved by ice and supposed to have been an attack of appendicitis.

His present illness began ten days previous to entering the hospital, at which time he had a cramp-like pain in the right lower quadrant. He vomited, and continued to vomit every day thereafter. He had lost considerable weight, but attributed this to lack of nourishment. On the day of admission he had a gastric hemorrhage of bright blood, mixed apparently with old clotted blood. The hemorrhage was moderately severe and resulted in an elevated pulse rate and a considerable degree of anæmia.

The patient was kept under observation for a period of three weeks, during which time a study of his condition revealed the following: Age, general appearance and loss of weight, were suggestive of malignancy. An X-ray examination of the gastro-intestinal tract revealed a large protrusion on the lesser curvature of the stomach, which was characteristic of a per-

RESULT OF OPERATION FOR RHINOPHYMA

forating ulcer. This was a constant finding, and the extent of the involved area further suggested malignancy. Both stomach and bowel contents contained blood. He had a low gastric acidity, both hydrochloric and free acid. His hæmoglobin ranged between 45 per cent. and 68 per cent. The provisional diagnosis was perforating gastric ulcer of the lesser curvature with malignant degeneration.

October 4, after a preliminary blood transfusion, the abdomen was opened through a long right rectus incision. On the posterior wall of the lesser curvature of the stomach, there was a large chronic, indurated ulcer with a definite crater, which easily admitted the tip of the first finger. This was found to have perforated the posterior wall of the stomach into the substance of the body of the pancreas, where there was a large indurated area of approximately the size of a hen's egg. It was difficult to determine whether the condition presented was malignant or benign. A piece of tissue and an enlarged lymph-gland were removed from the gastrohepatic omentum for immediate frozen section, and the pathologist reported that there was no evidence of malignancy. The appendix was adherent in the pelvis and showed definite evidence of previous attacks of infection. There was also a perimembranous colitis, which, in one place, angulated the cæcum. The character and location of the ulcer did not lend itself well to resection.

The following procedure was carried out: (1st) Gastrotomy, with a linear opening on the anterior wall of the stomach. Good exposure of the ulcer was obtained, and its base, edges and bottom of the crater were thoroughly destroyed with the actual cautery. The wound in the stomach was closed with two continuous rows of chromic catgut sutures. (2nd) A posterior no-loop gastrojejunostomy was done with Roosevelt clamp, and the usual three layers of continuous chromic gut sutures. (3rd) Appendectomy. (4th) Release of angulation of cæcum by dividing the band of Jackson's membrane, which extensively covered it and appeared to interfere with its normal contour and function. The wound was closed in the usual manner without drainage.

The patient made a very satisfactory recovery and has been followed at regular intervals from time to time. He is entirely free from symptoms; has gained forty-three pounds in weight, and feels perfectly well in every respect.

This patient is presented to illustrate the following points:

1. The relation between certain types of appendiceal infection and gastric or duodenal ulcer.
2. The value of immediate frozen section as an aid in establishing the differential diagnosis between malignant and benign lesions of the stomach.
3. The value of so-called Balfour cautery operation, plus gastro-enterostomy in certain types of gastric ulcer, in which the location and extent of the ulcer do not lend themselves well to more radical operation. This particular operation has proved very satisfactory in a number of instances in our hands.

RESULT OF OPERATION FOR RHINOPHYMA

DR. WALTER A. SHERWOOD showed lantern slides taken of a man, seventy-two years of age, who for eight years had had a steadily increasing enlargement of the nose, which had recently increased to such proportions as to be a matter of great embarrassment to him. Over the lower half of the nose there was a large purplish-red lobulated growth of hypertrophied sebaceous glands, which hung down over the end of the nose and partially

obstructed the nares. Its appearance was typical of an extreme stage of acne rosacea, or what is commonly known as rhinophyma.

January 22 of this year, under local infiltration anaesthesia with novocain, he was subjected to a plastic operation with removal of the hypertrophied tissue from the bridge of the nose down to the end, including a thin strip of cartilage of the alae nasi. Hemorrhage was profuse, but this was controlled by pressure and heat, after which the entire area was covered with Thiersch skin grafts taken from the anterior surface of the left upper arm. The grafts were protected by a layer of silver foil and no other dressing was applied. At the end of ten days, the dried secretion was removed and all grafts were found to have taken. The appearance of the nose rapidly improved.

The patient is presented to show the result, which may be expected in advanced cases of this condition. The pathologist reported the removed tissue to be chronic inflammatory in character, with adenoma and cystic degeneration of the sebaceous glands. This is the third patient in whom a similar procedure has been followed by him with very gratifying cosmetic results in all.

DISARTICULATION AT THE HIP-JOINT FOR SARCOMA OF LOWER END OF FEMUR

DR. WALTER A. SHERWOOD presented a woman, forty years of age, who entered the Brooklyn Hospital, February 22 of this year, complaining of pain and swelling in the left knee of five months' duration. While getting into bed several months previously, she noticed a small lump on the back of the left knee. This gradually increased in size, with increasing flexion deformity. Walking had been difficult for the last two months. Swelling became painful about three weeks before admission, the pain radiating downward to ankle and foot. She remained in bed for a week and swelling subsided somewhat. She had lost ten pounds in weight before operation.

Physical examination was negative, with the exception of the local condition. At the left knee, filling the popliteal space and extending more to the lateral surface than to the medial there is a firm, fixed and moderately tender swelling. This mass extends longitudinally for 13 cm. and the circumference of the knee-joint at the point of maximum size was 39 cm. as compared with 29 cm. on the other side. In the inguinal region on the left side, there was a large palpable lymph-node about 1.5 x 2 cm. in size—movable and non-tender.

X-ray study made on February 1, 1927, showed a good-sized, well-defined rarefied area in the lower end of the left femur, just above the condyle. It was centrally situated, destroying the cortex, not expanding the bone, but there was slight periosteal reaction and thickening. The process had extended into the soft parts posteriorly and to the outer side and in soft parts, bony substance was seen. X-ray diagnosis—sarcoma of the left femur—osteolytic and osteogenetic. Radiographic examination of lungs and pleura for metastases, negative.

Patient had 85 per cent. of hæmoglobin and 5,620,000 erythrocytes. Coagulation time, 4½ minutes.

Clinically, this patient seemed to be an undoubted case of osteogenetic sarcoma, and while the eventual outlook for life was not good, the general opinion was expressed that in the absence of any evidence of metastases, she

ANEURISM OF FEMORAL ARTERY

was entitled to the benefit of radical measures, rather than to allow her to go on with nothing more than palliative treatment.

It was decided to do a high amputation and disarticulation of the hip-joint. February 24, under gas and ether anaesthesia, the common femoral artery was ligated as it emerged from beneath Poupart's ligament. This effectively controlled bleeding during operation, and was much more satisfactory than the use of Wyeth's pins or other constricting measures to control hemorrhage. With a racket-shaped incision, the joint was disarticulated and the limb removed. Muscle planes were sutured with chromic gut. Cigarette drain was introduced at either angle of the wound.

Present Condition.—Wound has entirely healed and general condition is gradually improving. Patient gets around fairly well on crutches.

Pathology.—This specimen has been studied, both in the gross and microscopically, by four pathologists. There seems to be a difference in opinion as to the exact histological nature of the tumor. The pathologist at the Brooklyn Hospital believes it to be a benign giant-cell osteosarcoma of the epulis type. Dr. James Ewing, who has also been interested in a study of this specimen, expressed the opinion that the growth was malignant telangiectatic osteogenetic sarcoma. He believes that the prognosis is bad, and states there was a difference of opinion in his own laboratory as to the true nature of this tumor.

It might also be stated that the lymph-glands removed did not show any evidence of metastases.

DR. CONSTANTINE J. MACGUIRE thought that the lack of trabeculation in the cavity spoke against the diagnosis of benign giant-cell sarcoma. He mentioned a case of supposed benign giant-cell sarcoma in Bellevue on which high amputation was done and the man died two years later with metastases in both lungs. One lung showed the microscopic picture of many giant cells, the only case the speaker had ever seen where lung metastasis contained giant cells.

ANEURISM OF FEMORAL ARTERY. ENDOANEURISMORRHAPHY

DR. JOHN E. JENNINGS presented a man, fifty-three years of age. Luetic infection thirty years ago when he was treated for eight weeks, none since. Eight months ago patient had an attack of pain in the right leg which was relieved by heat. Three months ago he noticed a small swelling in the inner and posterior portion of the right thigh about five inches above the knee which occasionally became painful. One month ago the swelling was the size of a silver dollar, since then it has been growing rapidly and now is the size of a small grape-fruit. Is occasionally painful.

Pulsating mass in the lower fourth of the right thigh presenting on the inner and posterior aspects, bruit and thrill.

Incision along the inner border of the sartorius over tumor eight inches long. The femoral artery was isolated above the aneurism, a Crile clamp set and the aneurism opened. Sharp hemorrhage from the lower opening plugged with finger. Two other openings of arteries about two inches apart were found on the posterior wall of a fusiform aneurism involving the lower femoral and in part of the popliteal artery. The openings were plugged with absorbent cotton pledgets wet with saline and tied to silk ligatures and an 18 F. catheter was placed along the posterior wall from one opening to the other and the wall sutured over it, forming a new channel after the

method of Matas. The tube was then removed and the sutures closed. Over this a layer of interrupted sutures. The clamp was then removed from the femoral, one point of oozing found in the suture line and closed by suture. Pulsation felt in the new-formed vessel and below it. Sartorius laid over sutured vessel. Skin closed with interrupted sutures and a plaster case applied. Primary union and the pulsation of the posterior tibial persists.

CHRONIC EMPYEMA

DR. JOHN E. JENNINGS presented a young man of nineteen years seen December 11, 1919, with a diagnosis of collapsed left lung; chronic empyema;

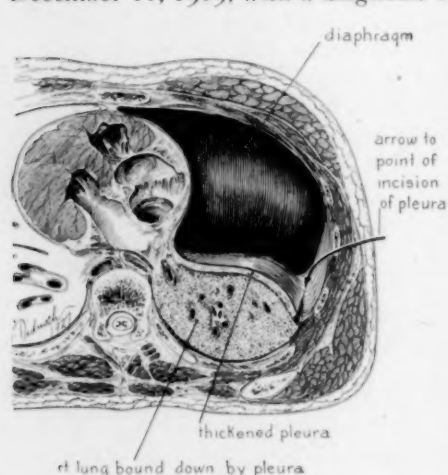


FIG. 1.—Cavity within chest.

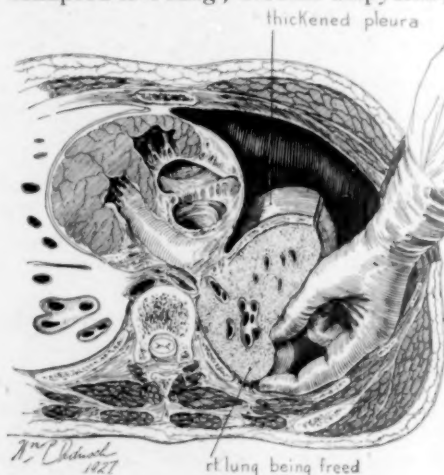


FIG. 2.—Freeing lung from confining false membrane.

phthisis dating back from March 8, 1918. He had been tapped several times in that period and operated upon on April 9, 1918. Has been draining ever since that time. He was sent into the Brooklyn Hospital, December 12, 1919, and operated upon under nitrous oxide and ether on December 15, 1919. Portions of ninth, eighth and seventh ribs removed. Two large drainage tubes inserted. January 5, 1920, he was taken again to the operating room and submitted to the first stage of a decortication. Lung stripped from its bed to a point beyond the aorta allowing lung to roll forward. Section of pleura downward in vertical direction from the transverse incision, freed the heart. Considerable expansion of lung noted.

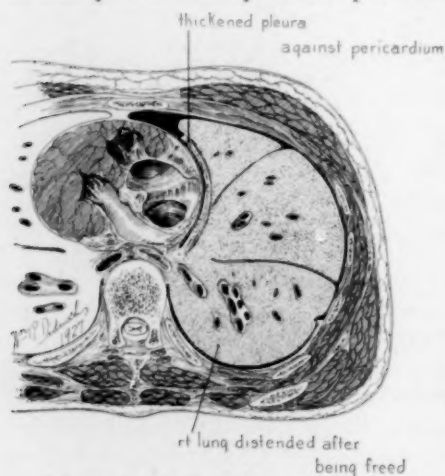


FIG. 3.—Restoration of thoracic organs to normalcy.

Patient did well and was discharged on January 23, 1919. On March 29 was admitted to the hospital again, having gained twenty pounds in the interim. On March 31, 1919, he was again operated upon for the second stage. Lung was discovered lying behind a dense layer of false membrane. This was stripped

CHRONIC EMPYEMA

FIG. 4.—Thoracotomy: The skin flap formed.

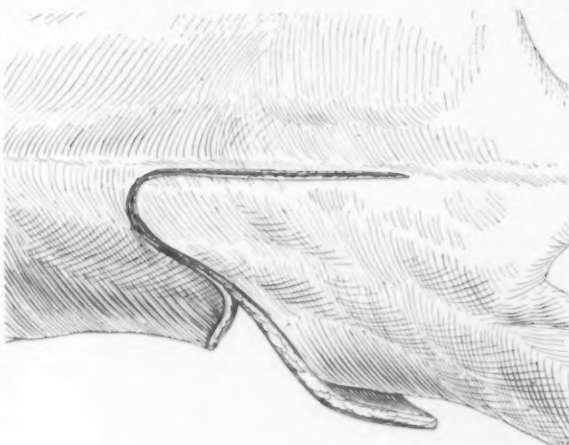


FIG. 5.—Thoracotomy: The skin flap raised.

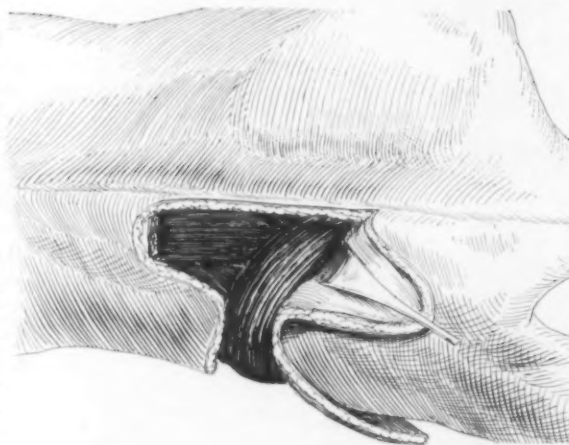
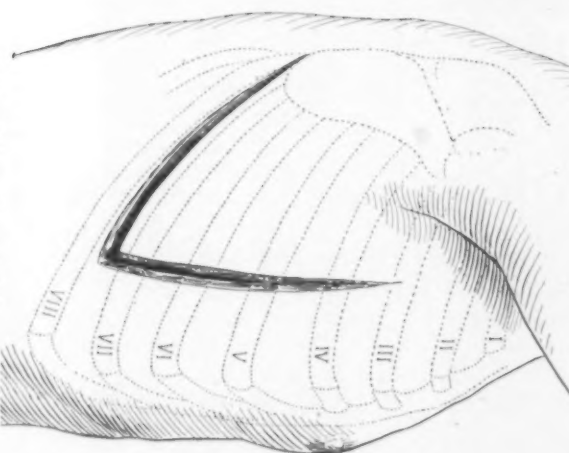


FIG. 6.—Thoracotomy: The bony section.



off the lung at a point about opposite the interlobular fissure. Lower lobe first dissected as far back as, and beyond the aorta and brought forward. Upper lobe was also freed and false membrane was removed well beyond its adherence to the lung. (Figs. 1, 2, 3.) Flap of chest wall underlying scapula mobilized and allowed to drop back, secured by sutures of heavy catgut. Portions of the sixth, seventh, eighth, ninth, tenth ribs removed low down, allowing pouch at the bottom of the cavity to collapse. Rubber drainage tube. Did very well and was discharged on May 4, 1920,

with small sinus still present, very little discharge. Good expansion of lung.

He did very well for quite some time after this. The sinus opened and closed. When closed he had sweats, expectoration of pus and blood and fever. Relieved when it opened again. Lost about eight pounds and quite a good deal of his color. Sent back to the Brooklyn Hospital for investigation and operation if necessary. Admitted on June 2, 1921, and again operated upon June 13, 1921. Incision behind left scapula disclosing sinus surrounded by new-formed bone. Portions of sixth, seventh and eighth ribs removed with new-formed bone, revealing large cavity within

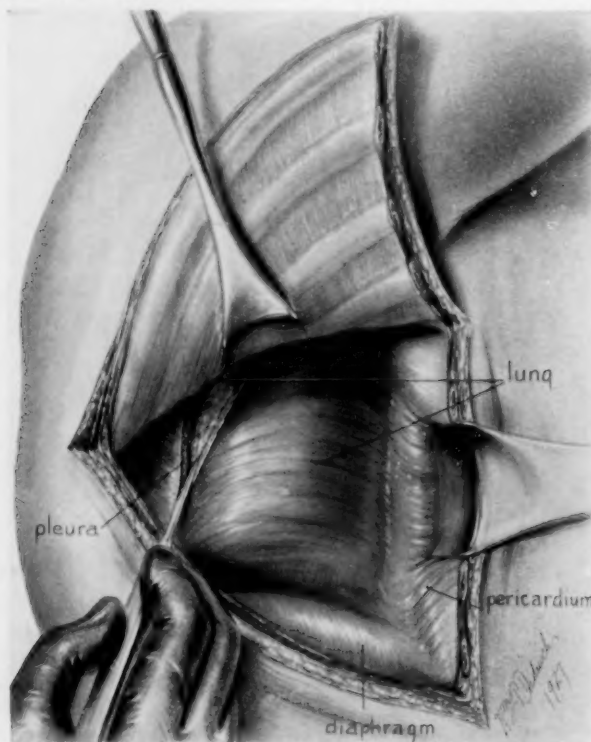


FIG. 7.—Thoracotomy: The binding false membrane exposed.

chest, extending from third rib down to lower limit of cavity. Small bronchial fistula in lower portion of cavity, further removal of ribs so as to allow drainage of lower portion of cavity. No sutures. Left the hospital again on August 4, 1921, with fistula still not closed. To return later, which he did on January 8, 1922. Incision made around old sinus with removal of old rib formation making an opening six inches long through chest wall, revealing cavity about eight inches long and three-quarters inch in depth at the bottom of which a small bronchial fistula could be seen. Suture set about the orifice of fistula. Zinc oxide gauze pack. Discharged January 29, 1922, with a rather large wound discharging moderately. He finally closed up and is now well, although still quite slender.

The other case* is a fireman, forty-one years of age. First seen October 7, 1919. He had a pneumonia in March, 1918, and an empyema. Was operated on in April, 1918. His side was drained with two tubes for two weeks and then with one tube for five weeks. It closed on the 24th of

CHRONIC EMPYEMA

June, 1918, but soon opened again. He was again operated upon on September 4 and drained for four months. Then he went to Bellevue where bis-muth paste was injected and it closed again in January, 1919, but in March, 1919, it opened once more and had been draining steadily since. He was admitted to the Brooklyn Hospital on October 4, 1919, and the next day an excision of the old scar and sinus and an exposure of a very large and thick-walled cavity was made with decortication. The expansion of the lung and obliteration of the cavity was prompt and satisfactory and he left the hospital on November 11, 1919, in good condition. He had no trouble for twenty months, when an abscess formed in the scar and broke down. A sinus was followed to a rib sequestrum, which was removed, and his sinus quickly closed and has remained so.

In both these cases as in three others in which the operation was performed, the lung lay completely collapsed along the spine covered by a thick pleura.

They presented, each of them, a story of more than two years' continuous and inadequate drainage.

The same procedure was followed in both these cases—a wide flap opening of the thorax, an incision along the outer edge, finding the lung. Dissection between the buried lung and the thoracic wall, leaving untouched the pleura covering the lung in front. This is essentially the procedure of DeLorme as described by him save that he cut through the pleura in front of the lung, stripping it back as well as lifting the lung. (Figs. 4, 5, 6, 7, 8 and 9.)

Fowler's description and this practice, as I knew it, was limited to clearing the face of the lung. This is not in my experience as important as is the freeing of the lung from its bed.

In late cases it is also dangerous. The adhesions between the pyogenic membrane, so called, and the pleura-covered lung, are dense and in old cases it is almost impossible to strip the lung in this way without wounding it. Especially true is this in the neigh-

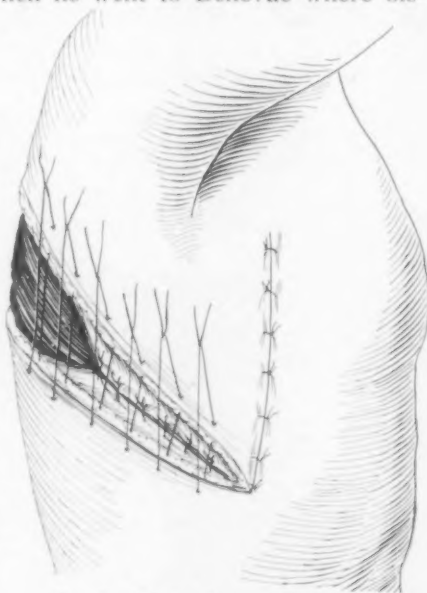


FIG. 8.—Closing the operation wound.

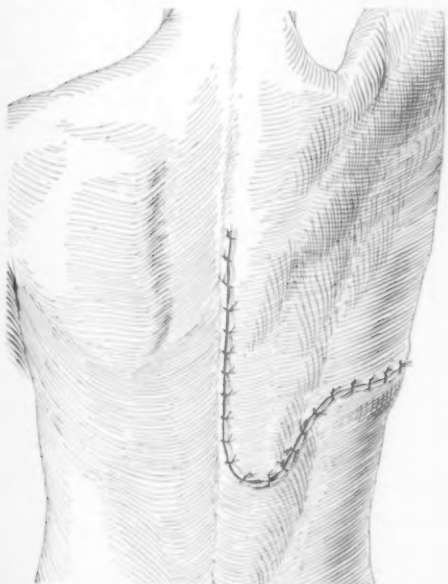


FIG. 9.—The final line of external suture.

borhood of the diaphragm. Behind the lung, on the other hand, there is adhesion, it is true, but one between two serous surfaces, parietal and visceral pleura, it is easier to free the lung without damage.

In the second case this was accomplished with success. In the first the lung was torn, a fistula developed and final closure was accomplished only after a transplant of muscle tissue had been used to fill the cavity. (Fig. 10.)



FIG. 10.—Transplant of muscle to fill persistent intrathoracic cavity.

THROMBO-ANGIITIS OBLITERANS. SYM- PATHECTOMY

DR. JOHN E. JENNINGS presented a man, aged forty-four, who was admitted into the Brooklyn Hospital, February 21, 1923, with throbbing pain in right foot with swelling, redness and scaling at the end of second and third toes, for seven weeks.

Had an operation nine years before when a piece of bone was removed from great toe following severe swelling and discoloration of foot coming on suddenly without apparent cause. In bed nine months at this time.

March 16 he was operated upon by an incision eight inches long along inner one-third of thigh over sartorius. Sartorius muscle retracted to the outer side, revealing Hunter's canal. Canal opened, vessels exposed, femoral artery separated, tape-loop retractor. Sympathetic plexus incised, eye spud inserted underneath. Sympathetic layer cut with fine knife, using spud as director. Lid retractor slipped between artery and freed sympathetic plexus. Plexus stripped for distance of two and seven-eighths inches. One vessel in middle denuded area clamped and tied. Small vessels at either end of area clamped and tied. Sartorius replaced with plain catgut sutures. Silkworm gut to skin. Second and third toes removed. Amputated at middle metatarsal joint. Long plantar flap. Hemorrhage scanty. Chromic catgut sutures. Iodoform pack.

Second operation—April 18, 1923, under ether anaesthesia. Nine-inch incision made from a point four inches above the knee on the inner surface upward and outward to a point eight inches below the anterior superior iliac spine in the midline. The sartorius was lifted from its bed and retracted inward. Hunter's canal was opened and the femoral artery dissected out for

LUDWIG'S ANGINA

a distance of three inches. A small muscular branch was tied one-quarter of an inch from the main trunk. The adventitia was opened, split and skinned away for a distance of three inches. Interrupted chromic sutures were used to close the fascia. Similar sutures were used to close the skin.

Laboratory Report.—Thrombus arteritis obliterans (late stage).

He was discharged from the hospital on May 18, 1923. On October 17, 1923, he came in for final check up. Pain and soreness ceased entirely about September 1, 1923. Foot is now quite healed and perfectly comfortable.

It has been generally agreed that the operation of Leriche—peri-arterial sympathectomy—would be useless in cases of Buerger's disease. Leriche himself says in his book just published, "I have never treated a case and speak without experience."

The speaker had performed the operation as he understood it on six cases of actual gangrenous processes involving the toes. In five, the gangrene has been and remains arrested. In one it continued to spread and amputation below the knee was performed. In two, arrest of pain and complete restoration of function took place. In one, slow healing and slow but steady improvement with attacks of pain growing less. In two, slow healing but some relief from pain.

DR. FREDERIC W. BANCROFT said that in Baltimore recently, Dr. Dean Lewis showed three cases of thrombo-angiitis obliterans, in which he had ligated the femoral artery immediately below the origin of the profunda branch; he excised about three inches of the artery.

Doctor Lewis bases his principle for this procedure—(1) When gangrene of the leg does occur, it is due to thrombosis of the popliteal artery, and if the blood supply is cut off before this occurs gangrene may be prevented. (2) Injected specimens of legs amputated for this condition show marked compensatory circulation and will therefore stand very well the shutting off of the blood stream of the femoral artery.

His patients were free from pain, one year post-operative, and there was no evidence of gangrene.

LUDWIG'S ANGINA

DR. JOHN E. JENNINGS presented two cases of Ludwig's angina. The first, a case of somewhat slow development of the disease, started March 12, 1917, with a right-sided tonsillitis which formed a peri-tonsillar swelling. Incised on the third day—no pus and no relief. Again incised the next day as the swelling was increasing—no pus and no relief. Then a hard mass developed on the right side near the angle of the jaw and he began to have some difficulty in breathing and swallowing. On the fifth day about one dram of pus appeared in the tonsil incision. There was no relief in swallowing or in breathing. Then the submaxillary mass increased in size. An incision was made. Still no relief. On the seventh day the swelling extended to the floor of the mouth and across to the left side. On admission to the Brooklyn Hospital on April 2 the floor of the mouth was cedematous and swollen, the tongue lifted high. An incision was made under the jaw on the right side and two rubber drainage tubes inserted, one to the angle of the jaw and the other below the tongue. He was discharged on the 8th of April from the hospital and was all healed on the 23rd of April.

The other case was a woman of about fifty years of age. Admitted

to the Brooklyn Hospital on January 12, 1923. Five days before admission had a severe sore throat with tonsillitis with false membrane which was suspected of being diphtheritic. The culture, however, was negative. Twenty-four hours before admission the floor of the mouth and the tongue became greatly swollen, the swelling extending from the left side with intense pain. On admission the floor of the mouth was greatly swollen and œdematous, having risen to the level of the lower teeth. The tongue enormously thickened and filling the oral cavity. Swallowing was quite impossible and dyspnoea beginning to be pronounced. On January 12 under

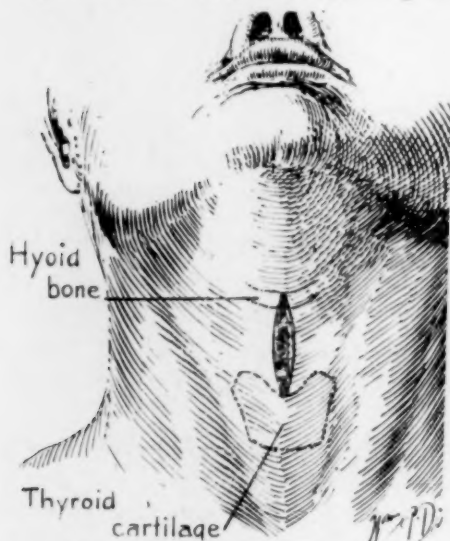


FIG. 11.—Incision for Ludwig's angina.

chloroform anaesthesia an incision made in the midline of the neck between the tip of the chin and the hyoid bone. A finger in the incision recognized the hyoid and forceps were thrust through the mylo-hyoid into the floor of the mouth under the tongue. (Figs. 11 and 12.) A rubber drainage tube was inserted. A secondary incision below the left angle of the jaw and countercommunicating drainage between the two incisions was added. The patient did not do well. She was delirious and cyanotic. It was evident that a tracheotomy must be done and that the tongue was not sufficiently drained. January 14, 1923, this was accomplished none too soon. She ceased breathing on the operating table and a hasty, high tracheotomy was done.

Exploration of the previous incision showed that it extended well into the floor of the mouth, but not into the body of the tongue. The finger reach had been too short. A No. 32 F. male sound was thrust into the tongue along the drainage tract with the evacuation of pus and blood and a tube drain replaced. Her condition was critical for a few days, nasal feeding was necessary for several days, after which her convalescence was rapid. The tracheotomy tube was removed ten days after its insertion. She began talking in about a week. The tongue remained much swollen for six weeks.

Ludwig's angina is recognized as a condition with a rather high mortality. It is a gangrenous myositis of the intrinsic muscles of the tongue and of the floor of the mouth associated with profound toxæmia and with great danger of an œdema of the glottis. It is usually treated by lateral, submaxillary incision and its accredited mortality is 40 per cent. The reporter had treated since 1913 ten cases with one death, a fortunate result, for which the procedure to be described is in part responsible.

A median incision is made under chloroform anaesthesia, from the upper edge of the thyroid cartilage upward one inch. This is carried down to the hyoid bone. The point of the scalpel is thrust through the fascia and the mylo-hyoid muscle above the hyoid and a pointed clamp or scissors entered in its place. This is opened and a finger thrust deeply into the body of the

GALL-BLADDER RÖNTGENOGRAM SHADOWS

tongue which will be found to be gangrenous. The finger is then turned and hooked into the tongue so that its tip can be moved by the finger. If the neck is too thick and the finger too short a 32 F. male sound with a Van Buren curve is used instead. A large tube drain is inserted deeply. It may be necessary to drain one or both submaxillary regions as well, but the deep lingual drainage is essential. In cases of doubt a low tracheotomy should be done.

DR. JOHN C. A. GERSTER said that, not knowing about Doctor Jennings' method, he had used the same procedure about six days ago. The patient had had a lingual abscess which had been incised about ten days previously by his family physician and quite a large amount of pus evacuated. He did not return for treatment, and gradually developed a tender swelling of the entire sublingual region, including that part of the tongue just in front of the glottis. When Doctor Gerster saw him he had no fever and only slight difficulty in swallowing. He was kept under observation for a few days because of the possibility that the symptoms would subside. At the end of the fourth day there was a rise in temperature to 100.8° , and the swelling had increased in size. Doctor Gerster made a transverse incision, just above the hyoid bone, went into the depths of the tongue in the midline, and struck a foul abscess, pus from which showed bacteria on spread but gave negative aerobic culture. The laboratory was unable to make an anaerobic culture. The man stayed in the hospital for three days and then left in good condition, having no fever and no pain on swallowing. The submaxillary induration was painless, but still persistent. There was a moderate amount of drainage.

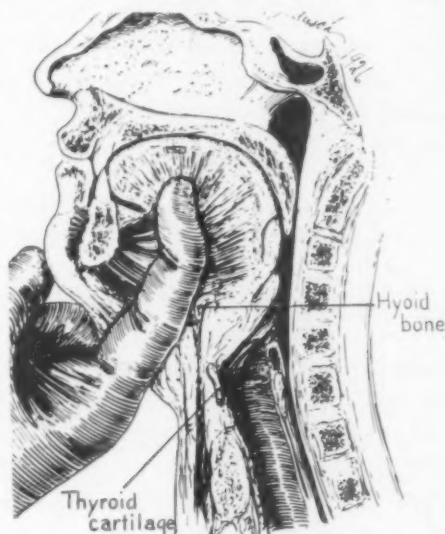


FIG. 12.—Finger thrust up into centre of infected area.

GALL-BLADDER RÖNTGENOGRAM SHADOWS

DR. FRANK S. MATHEWS showed cholecystograms with unusual features. A patient for a long time had had attacks of pain after bed time suggesting gall-bladder but not quite so severe as those of ordinary cholelithiasis. The dye was given by mouth and was wholly absorbed. The first exposure showed an unusually large, clearly defined gall-bladder larger than any he had seen. He estimated its capacity at four ounces. The first film after taking food showed a gall-bladder practically the same size as before. Exposures were made over a period of two and a half days, in all of which the gall-

bladder shadow was visible, becoming progressively smaller, with possibly deepening shadow. At operation, the gall-bladder was found everywhere adherent, the fine adhesions probably resulting from a previous operation. The gall-bladder was both large and thin and had the usual normal blue color. The mucosa appeared normal. The pathologist reported atrophic gall-bladder. The epithelium was everywhere well preserved. The interest in the case lies in the prompt filling, the unusual size of gall-bladder, the inability to empty in two and a half days, the association of this condition with fairly definite clinical attacks. It is also of interest that a gall-bladder demonstrated to be one with an unusual degree of stasis apparently over several years, yet showed no tendency to formation of stones nor inflammatory signs in its musculature or mucosa.

SIDE-TRACKING OPERATIONS FOR COMMON AND HEPATIC DUCT OBSTRUCTION

DR. ALLEN O. WHIPPLE read a paper with the above title, for which see page 540.

DR. WILLIAM CRAWFORD WHITE said that he happened to be in Boston March 3, 1927, when Dr. Hugh Williams showed the case Doctor Whipple had referred to as a nine-year post-operative cure. The patient was a small boy four years of age in 1913, at the time he had had the fistula; so it was fourteen years since operation, last March. He had gone to the Massachusetts General Hospital this time with acute appendicitis, and they had felt sure his symptoms must relate to his former condition. It proved to be entirely separate and distinct.

DR. HUGH AUCHINCLOSS added one case to those Doctor Whipple had presented. The patient was a woman, who had had the ordinary gall-stone symptoms and had a large gall-bladder containing a number of stones. The gall-bladder was removed. Two days later the laboratory reported a small area of carcinoma in the wall of the thickened chronically inflamed gall-bladder. One gland in the region of the free margin of the lesser omentum had been noted. The patient went for about a year before returning with increasing jaundice. She was again operated on and the free margin of the lesser omentum found to be here much thickened and hard, so that structures in it were unrecognizable, and though it was impossible to determine whether this was inflammatory or carcinomatous, the presumption was strong that it was carcinoma. No specimen could be removed with safety from this mass. Doctor Auchincloss was inclined to abandon the idea of doing anything, but by dissecting toward the portal fissure a small triangular portion of the hepatic duct was found distended and available for anastomosis. The stomach lay near, so that it was possible to unite the stomach to this triangular area. This was done by uniting the stomach to the hepatic duct posteriorly by a continuous suture. Then three or four Halsted mattress interrupted sutures were placed but not drawn taut, to unite the two structures anteriorly. By holding these up as in a Finney pyloroplasty, it was possible to make a

SIDE-TRACKING COMMON DUCT OBSTRUCTION

hole in the stomach and then in the small triangular area in the hepatic duct and complete the anastomosis by simply tightening and tying the mattress sutures. Another patient had a simple cholecystectomy done that same day. It was thought the simple case would do well and the other patient probably would die. The contrary proved to be the case, for the simple case had a stormy few days while the patient with anastomosis had an easy convalescence and had soon lost all evidences of jaundice. After several months' remission, however, her jaundice returned and she died at home. This case shows that in spite of progressive jaundice and malignant metastasis with only a small amount of dilated hepatic available duct it is sometimes possible to give temporary relief.

DR. JAMES N. WORCESTER said that the question of the etiology of pancreatitis is obscure and the only thing one could ascribe it to is infection of the biliary tract. He had seen considerable benefit follow gall-bladder drainage with subsidence of the chronic pancreatitis and spontaneous closure of gall-bladder fistula. It seemed to him this simple procedure was a possibility which should be considered.

DR. FORDYCE B. ST. JOHN said that inasmuch as prophylaxis should be considered in handling these cases, it seemed to him that in spite of the fact that there were good results in the case he was interested in, it might have been prevented by being satisfied with simple drainage, rather than cholecystectomy during which the hemorrhage took place.

DR. EDWIN BEER stated it was difficult to decide whether the increasing number of cases of complicated post-operative pathology of the biliary tracts was due to the fact that more surgeons were doing gall-bladder work, or whether perhaps some of these unfavorable results had developed as a result of the recommendation to remove the gall-bladder by starting at the cystic duct end. This latter technic surely is somewhat risky not only in acute infections but even in interval cases. Using this technic, throwing the ligature around what seemed to be the cystic duct and then dissecting from the fundus down to the ligature which had been left untied, on several occasions he had found that the ligature surrounded the right hepatic or common hepatic ducts rather than the cystic duct, demonstrating very clearly the danger in some of these cases of this procedure. He also felt that the use of the bridge and introduction of drains towards the gastro-hepatic ligament while the patient was still on the bridge, might contribute by fixation and scar tissue development to some of the angulations in the deep ducts which make for permanent obstruction—partial or complete. A drain placed in this way could readily, as soon as the bridge was dropped, press against the deep ducts and pull them forward as soon as the bridge was lowered. If the drain were gauze, the danger of such traction would be much greater than when using a rubber tube or rubber-dam.

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A MODIFIED SUPRA-PUBIC PROSTATECTOMY*

EUGENE FULLER's supra-pubic prostatectomy has received very little modification since its origin, with the exception of the control of post-operative bleeding by suture and by the Pilcher bag. From the standpoint of technical refinement, the usual supra-pubic operation cannot be compared

with the anatomic perineal prostatectomy of Young. The removal of the prostate, supra-pubically, is generally so simple, by the average technic, that it can hardly be called a major surgical procedure; the danger from the operation depending mostly upon the general condition of the patient. Perhaps the most undesirable result is the loss of the membranous urethra, leaving the bladder mucosa and the upper end of the remaining urethra separated for several inches. After natural processes have made a channel connecting the urethra and bladder, the passageway is frequently tortuous and obstructed, producing no little difficulty for the patient in emptying his bladder.

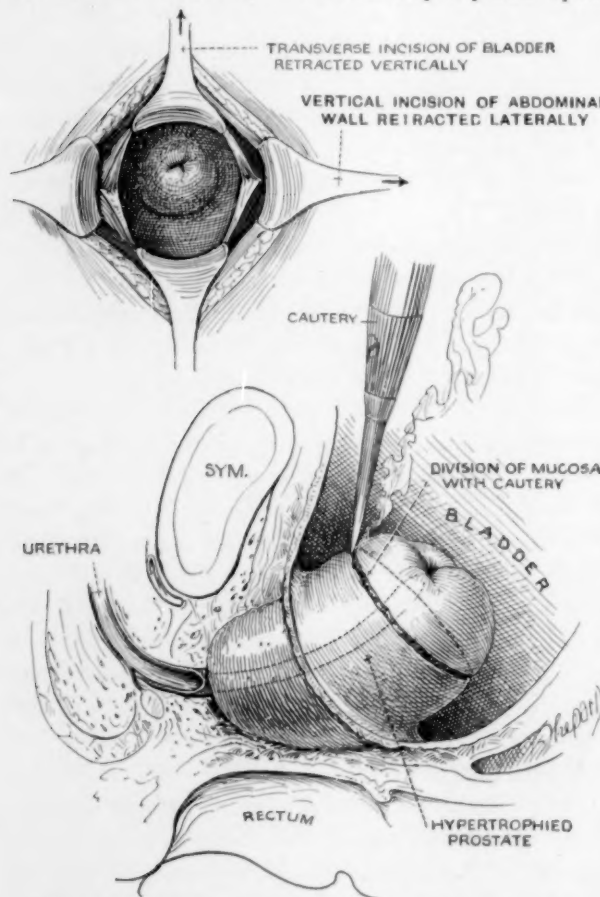


FIG. 1.—The prostate should be shown pulled upward by corkscrews. Note the transverse incision in the bladder which allows ample exposure.

The operation I am presenting may have some advantages over the older and well-tried Fuller procedure. It cannot be performed on patients whose general condition will permit only a hasty enucleation and in those patients whose prostates are fixed *in situ* by adhesions. When this operation can be per-

* From the Department of Surgery, University of Nebraska.

A MODIFIED SUPRA-PUBIC PROSTATECTOMY

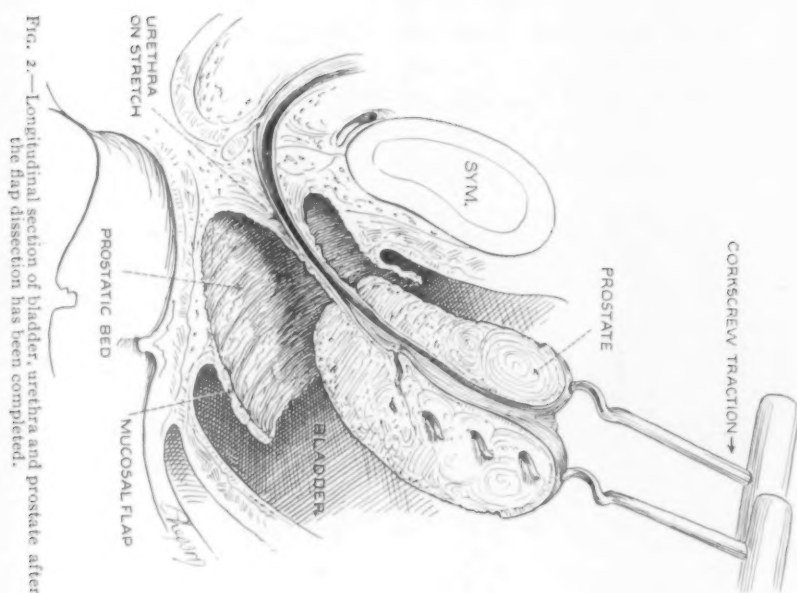


Fig. 2.—Longitudinal section of bladder, urethra and prostate after the flap dissection has been completed.

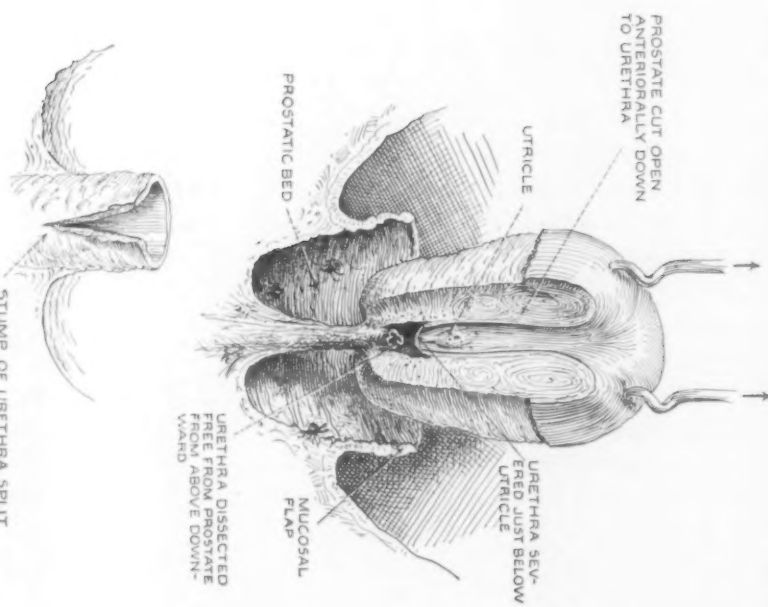
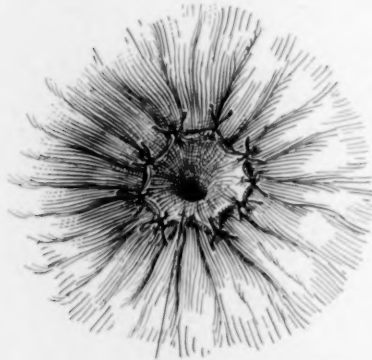


Fig. 3.—The prostate is split through the region of the anterior commissure. The lower fourth of the prostatic urethra is not split until after it is dissected from the prostate.

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formed, it results in: (1) Control of bleeding; (2) a direct union of the lower prostatic urethra with the bladder mucosa, resulting in a more patent urethra; and (3) a smoother post-operative recovery. The disadvantages of this operation are its difficulty of performance and the length of time required. When the technic of this operation can be carried out, the post-operative loss of blood is so slight that it can well be compared with Edwin Davis' technic which he has so successfully devised to prevent bleeding during his performance of Young's Anatomic Perineal Prostatectomy.

Technic.—As stated previously, the medium size hypertrophied prostate,



SPLIT URETHRA SUTURED TO MUCOSAL FLAPS OF BLADDER

FIG. 4.—The bladder mucosa sutured to the urethra. There is a greater amount of bladder mucosa as compared with the urethral than is shown in the illustration. Three or four interrupted sutures are about all that can be inserted.

not firmly fixed by adhesions to surrounding structures and with a membranous urethra which allows for considerable stretching, are the anatomical conditions desirable for the performance of this operation. When the patient's general condition is not satisfactory and a speedy operation of a few minutes' duration is essential, this operation, at present, is not recommended.

A vertical incision through the abdominal wall and a transverse incision through the bladder gives the best exposure. Ordinary cork-screws are forced into the prostate for traction and an electric cautery blade, or preferably a very sharp knife, is used to cut the bladder mucosa around the midlateral portion of the prostate. The bladder mucosa is then cut away from the lower portion of the prostate with scissors, or brushed away with gauze. Steady traction on the screw handles with upward pressure in the rectum, soon elevates the prostate and puts the urethra on a stretch. An intravesical lamp is desirable, particularly when suturing the bleeding points in the prostatic bed. After the prostate has been liberated, it should be split open through the anterior commissure. This is easiest done with a scissors, placing one blade within the urethra. The lower third or fourth of the membranous urethra is then dissected from the prostatic bed. After this portion of the prostatic urethra has been dissected from the prostate, it is split for about one-half inch downward in its anterior portion and attached to catgut sutures which keep it in view. The prostate, which is now unattached, is then removed from the bladder and the bleeding in the prostatic bed attended to with sutures. The mucosal flaps in the bladder are attached to the urethra by interrupted fine chromic gut sutures which is the most tedious part of the operation. Only about three or four such sutures can be used. A small rubber catheter, no larger than No. 17 F., should be inserted through the

SUBACUTE GASTRIC PHLEGMON

urethra and left protruding into the bladder. A supra-pubic drain should be left in four or five days.

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SUBACUTE GASTRIC PHLEGMON*

A man, aged forty-six years, entered the Wesley Memorial Hospital, November 12, 1926, with signs and symptoms of an acute appendicitis, that started thirty-six hours previously. For the past month, patient had not been feeling well, was weak and felt vague abdominal distress. Temperature 98.6, pulse 80, leucocyte count 12,000. A grid-iron incision was made under combined novocain, nitrous oxide and ether anæsthesia. The appendix was found to be embedded in the lateral wall of the cæcum with its tip perforated into the mesocolon of the ascending colon. It was freed and amputated at the base. A large mass of thickened, friable omentum covered the cæcum. Both in the omentum and in the mesentery, several chains of lymph-glands were palpable. No mesenteric thrombosis was noted. The abdomen was not explored and the wound was closed except for a small strip of gauze inserted in the subcutaneous tissue. There was a foul discharge for a few days. The wound was completely healed on the twelfth day and patient discharged on the sixteenth day after operation. There were no chills during convalescence.

The appendix was 12 centimetres long. There was a kink close to its tip. It is here that perforation took place. Histology showed an acute suppurative appendicitis.

The man returned to work and felt completely well. Two months after the operation, he suddenly developed a pain in the epigastrium and under the right costal margin. This pain was dull, constant, had no relation to food and did not radiate. He did not vomit. His temperature had risen to 101° Fahrenheit.

He was seen on February 11, 1927, three weeks after the onset of the new symptoms. Examination revealed a vague, slippery, tender mass in the epigastrium, which extended to the right lobe of the liver and followed respiratory movements. His temperature was normal, pulse between 90-100; blood-pressure 125-80. Laboratory findings were: Red blood-cells, 4,000,000; white blood-cells, 16,000; hæmoglobin, 85 per cent. Wassermann reaction was twice negative. Gastric analysis showed F. H. A. 59, T. A. 76, no blood and lactic acid were present. The X-ray findings revealed an irregularity of both lesser and greater curvatures, a prepyloric defect and a deformed duodenal bulb. There was a large residue at the end of five and a slight residue at the end of twenty-four hours.

The pre-operative diagnosis was a pyloric stenosis, probably due to inflammatory extragastric compression. Patient was given a gastric lavage three times before the operation. His last leucocyte count dropped to 7000, thus indicating a subsiding inflammation.

Laparotomy was performed on February 14, 1927. Midline incision from xyphoid process to the right of the umbilicus was made under combined novocain-nitrous oxide anæsthesia. The peritoneum was adherent to the anterior wall of the stomach and could only be opened to the left of the midline. A soft boggy mass was exposed of the size of a child's fist involving the lesser curvature of the stomach, the suspensory ligament, the right lobe of the liver and the anterior peritoneum. The stomach was freed from

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these structures. The entire anterior wall was hyperæmic, œdematous. The pylorus was open; the first portion of the duodenum was pulled upward toward the inflammatory mass, thus explaining the duodenal deformity. Both lesser and greater omentum were thickened and several lymph-nodes were palpable both here and at the pylorus. The stomach was well mobilized from pylorus to the ascending portion of the lesser curvature and about three-fifths of the stomach was resected. The pylorus was closed in three layers and covered with omentum. The upper half of the gastric stump was closed and inverted; the lower half was anastomosed with a short retrocolic jejunal loop. The cut wall of the stomach did not bleed, was glassy in appearance. The abdominal wall was completely closed.

Gross Pathology.—The resected part of the stomach showed two small erosions on the lesser curvature about 4 centimetres from the pylorus. A large area of the mucosa was dark red, almost hemorrhagic. The wall of the stomach was markedly thickened, œdematous with a translucent appearance. The serosa was covered with a large mass of fibrinous exudate. It gave the macroscopic appearance of a diffuse phlegmon. For histological study two sections were taken, one from the site of the erosion at the angle of the stomach, the other from the cardiac end of the resected portion.

Post-operative course was uneventful except for a diffuse bronchitis during the first three days. Bowels moved on the third day. Stitches were removed on the eighth day and primary union was obtained. He was put on a modified ulcer diet for two weeks, after which a general diet was permitted with five meals a day.

Three weeks after the operation a fractional test made showed no free acidity in any portion, total acidity varying from 18 to 29 points, no lactic acid and a faint trace of blood. X-ray on March 8, 1927: The stomach holds 10 ounces readily. There is a definite retaining power of the stomach. Peristalsis vigorous and progressive. There is no dilation of the proximal or the distal loop. After three and a half hours there is a slight residue of barium in the stomach. After four and a half hours the suture line of the closed pouch is faintly imbibed with barium. Red blood-cells, 4,280,000; white blood-cells, 4800; hæmoglobin, 75 per cent.

Six weeks after the operation, patient had gained twenty-five pounds and was ready to go back to work. He complained of some constipation. June 3, four months after the operation, patient was perfectly well, gained twenty-five pounds. August 1: No complaints, no anæmia.

Histological Report.—(Dr. R. H. Jaffé.) Section 1. The wall of the stomach is very much thickened. It measures from 14 to 16 mm. The thickening is due to the development in the subserous part of a cellular tissue which is composed mainly of large, round or oval cells with an ample foamy cytoplasm. The nuclei are round, rich in chromatin and often show an indentation of the membrane. Some of the cells contain small chromatin granules in the cytoplasm. Between these cells there are found a varying number of cells, lymphoid cells, eosinophile and neutrophile leucocytes. The latter cells arrange themselves in some places to dense clumps. Here their nuclei are often broken up and their outlines become indistinct. A few large giant cells with from 8 to 15 nuclei are found scattered between the other cells.

Thin-walled, capillary blood-vessels run through the cellular masses. Attached to their wall are seen round or oval cells with deeply stained nuclei and an homogenous slightly basophilic cytoplasm. In some of these cells single vacuoles are present and it is from these cells that the large foamy cells develop. This is demonstrated by numerous transitional stages.

In the middle of the cellular zone an oval area is observed. It is made up of degenerated leucocytes, structureless cell debris and shreds of fibrin. The foamy cells with the other elements arrange themselves concentrically about this area.

Toward the external surface of the stomach the tissue becomes denser and the

SUBACUTE GASTRIC PHLEGMON

foamy cells are less numerous. Lymphoid cells and polymorphonuclear leucocytes are predominating. This zone is very rich in new-formed capillaries which are dilated and filled with blood. In one place a group of foreign body giant cells is found. The cells are located about structureless hyaline masses with chromatin granules. A large artery found near this place has an obliterated lumen which is filled by a loose connective tissue with wide capillaries.

The cellular infiltrations extend into the muscularis. The foamy cells become gradually replaced by lymphocytes, neutrophile and especially eosinophile leucocytes. By these cellular infiltrations the muscle fibres often are widely separated.

The submucosa is thickened. A poorly stained fluid separates the fibrilles of the connective tissue. There are small perivascular accumulations of lymphocytes and eosinophile leucocytes. The lymph-vessels are much dilated and filled with a homogeneous mass. Many of them also contain polymorphonuclear leucocytes. The mucosa is oedematous with numerous large lymph follicles. The epithelium of the glands is rich in beaker cells.

Section 2.—The submucosa is the thickest portion of the wall. It is formed by loose connective tissue with much pale-stained material between the fibrilles. The lymph-vessels are dilated. The muscularis, too, shows a loosening of its structure by much fibrillar tissue separating the bundles of muscle fibres. A tag of granulation tissue is attached to the outside of the stomach. It contains an enormous number of giant cells which engulf structureless material stained purple or blue in the hæmatoxyline-eosine sections.

Diagnosis. Healing Phlegmonous Gastritis.—The foamy cells are histiocytes which have phagocyted lipoid material set free from breaking down pus cells. Remnants of the suppurative process still are visible in the foci of degenerated leucocytes. The process seems to have started in the subserosa.

Comment.—According to the histological report, the wall of the stomach showed a subacute inflammatory process, which started in the subserosa. The origin of the infection may have been in the appendix, which has been personally observed to cause very marked involvement of both veins and lymph-vessels in the omentum. The sections gave no evidence as to whether the infection was carried through the lymphatics or whether a retrograde venous thrombosis in the gastric vessels might have been responsible. That a lymphatic connection of appendix and duodenum and appendix and stomach is of clinical importance has been strongly emphasized by the studies of Flint (Moynihan). The possibility of retrograde venous thrombosis from mesenteric into gastric vessels has led Payr into excessive experimental studies. Omental ligations have been reported by Eiselsberg to cause gastric hemorrhage. The possible rôle of intra-abdominal infections, particularly of the appendix in gastric pathology, is suggestive in this case. This is all the more important as the gastric phlegmons hitherto reported originated in foul carcinomatous ulcers of the stomach, in gastric ulcers, or in diffuse polyposis of the stomach, the gastric wall being invaded from the mucous membrane; or as a localization of generalized infection as in a case of Meyer, Brams and Guy (see lit.). Most of these are post-mortem records, but a few cases recovered after gastrectomy.^{1, 2, 4} In our case, the process seems to have started in the subserosa, later invading the submucosa and causing mucous erosions.

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The history of the patient indicates that at the time of operation the acute symptoms were subsiding. Three weeks before admission, the patient's temperature was 101° Fahrenheit. On the day of admission, the white cell count was 16,000. On the day before operation, the white count dropped to 7000. Corresponding to this clinical picture, the microscopic sections show no acute suppuration, no abscesses as seen in the acute gastric phlegmon, but only small foci of degenerated leucocytes and an intensive phagocytosis. A granulation tissue dominates the field, the phlegmon is in a healing stage.

The motor insufficiency of the stomach was well marked by the twenty-four-hour residue of the barium meal. That the oedematous submucosa with its macrophages would have given place to a diffuse fibrosis is highly probable. We would then have a picture of a diffuse fibrosis of the stomach, a leather-bottle stomach, the inflammatory variety of which has only recently been emphasized by Wyard. Some of the so-called syphilitic and carcinomatous infiltrations may only be chronic inflammatory processes. Of the 38 cases of linitis plastica published from the Mayo Clinic only 80 per cent. were carcinomatous. (Lyons.) This condition then might be interpreted as intermediary stage, a missing link between an acute gastric phlegmon, which has been described by several authors and an inflammatory leather-bottle stomach, the etiology of which is yet undetermined. In the past history of such patients an acute stage seems possible but is not mentioned.

The gastric retention together with the diffuse involvement of the stomach indicated partial gastrectomy. A gastrojejunostomy might have flared up the phlegmonous process and would have left the infiltrated gastric wall to continue its process of involution and perhaps involve the new opening.

In Eiselsberg's case a gastric phlegmon developed after gastrojejunostomy made in the presence of a broken-down gastric carcinoma.

The partial gastrectomy, as very often seen, resulted in an anacidity, which, however, as shown by the undisturbed digestion of an unrestricted diet has no functional significance. After four months, no intestinal disturbance and no anæmia is present. The partial closure of the gastric stump, whereby only the lower half has been anastomosed with the jejunum, may have had an influence on the retaining power of the gastric stump which is present in the X-ray films as early as three weeks after the operation. Also the increase of the gastric capacity in such operations is well emphasized by this case.

Summary.—(1) A case of subacute diffuse gastric phlegmon is described, for which partial gastrectomy was done with complete recovery.

(2) This condition is interpreted on the basis of clinical and histological findings as an intermediary stage, a missing link, between a gastric phlegmon and a diffuse fibrosis of the stomach sometimes called leather-bottle stomach of the inflammatory type.

(3) Partial gastrectomy in this case was followed by good functional results.

VOLVULUS NEONATORUM

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VOLVULUS NEONATORUM DUE TO ANOMALOUS INTESTINAL ROTATION

A male infant, born January 20, 1924, appeared normal and healthy at birth, weighing 9 pounds, 8 ounces. On the second day he began to vomit dark green fluid and to pass blood from the bowels. He nursed well only part of the time and ejected most of the food in from twenty to thirty minutes. Vomiting, and blood in the stools increased progressively and he lost weight.

At regular intervals the stomach was lavaged and the infant transfused with small amounts of whole blood. By the twenty-fifth day there was marked distention of the abdomen, with visible peristalsis in the region of the stomach, leucocytosis of 22,000, and loss of weight of two pounds. Fluoroscopic examination at this time revealed an obstruction in the lower duodenum where the barium stopped. Congenital duodenal obstruction was diagnosed by Dr. J. G. Kramer who referred infant for immediate operation.

February 23, operation was performed by Dr. Carl R. Steinke through a rectus incision under light ether anaesthesia. When the peritoneum was opened the stomach popped out, because

it was greatly distended with gas. The gastrocolic omentum was torn about half its width, as the colon was fixed and not allowed to come out with the stomach. The transverse colon near the hepatic flexure was posterior to the first part of the jejunum, and

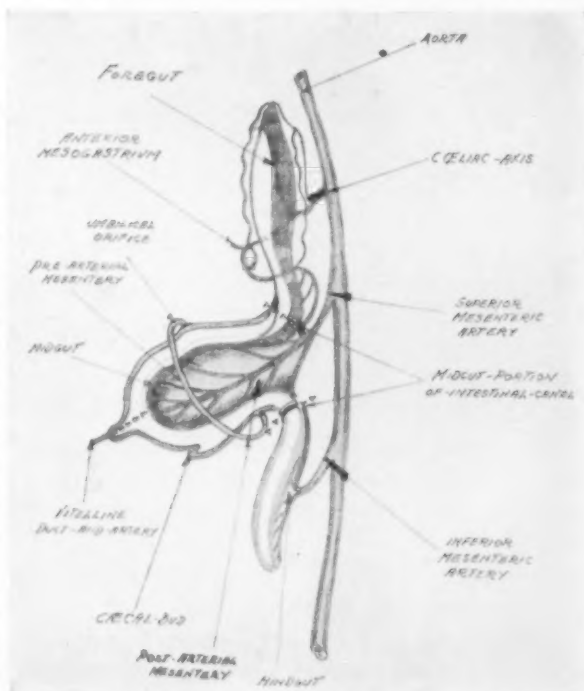


FIG. 1.—Schematic representation of primitive alimentary tract at about fifth week. (After Dott.)

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there was complete twisting of the small intestine over the colon. The jejunum was kinked, causing almost complete obstruction. The pyloric opening was dilated widely and the duodenum distended to 2 cm. in diameter down to the third portion where it was fixed. The whole intestinal mass was removed from the abdominal cavity and turned in a counter-clockwise direction, the colon being allowed to come in front of the first part of the jejunum. With relief of obstruction gas passed readily through the jejunum. The stomach was emptied of gas by pressure, through the œsophagus. The intestines and stomach were then replaced in the abdomen. The infant went into shock, so the tear in

the gastrocolic omentum was not sutured and the abdomen was closed rapidly.

Four days after the operation the weight dropped to 7 pounds 7 ounces, then began to increase steadily. The baby left the hospital, March 5, the eleventh day after operation. At this time the weight had increased to 8 pounds 3.5 ounces, the vomiting and hemorrhage had ceased entirely, and child had essentially recovered.

The volvulus in this case implicated the whole original midgut from the first part of the jejunum to the splenic flexure of the colon. The mass of intestine with its lack of fixation had rotated in the wrong (clockwise) direction, approximately one complete turn, or 360 degrees.

COMMENT

Anomalies of intestinal rotation are undoubtedly more common than a review of the literature would indicate. The cases without symptoms, and

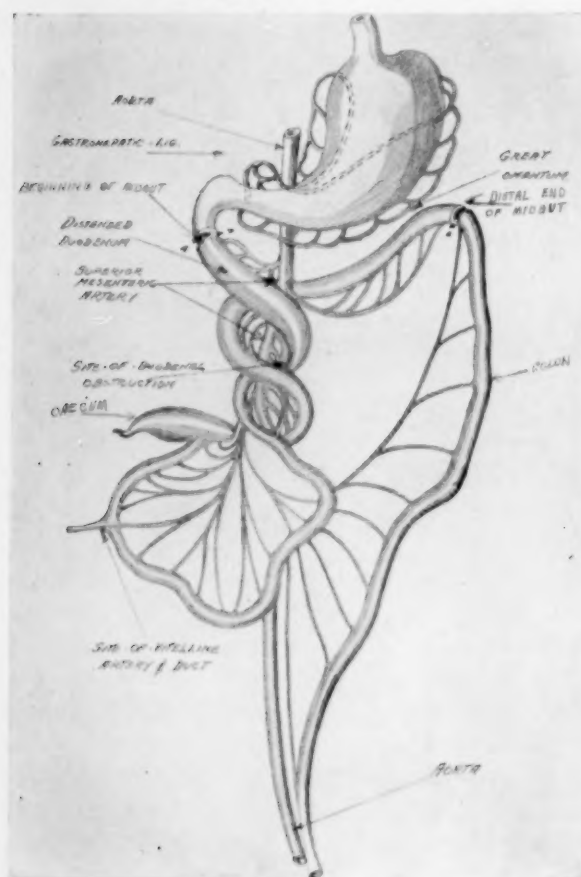


FIG. 2.—Volvulus of midgut. Twist of approximately 450 degrees in the wrong (clockwise) direction. (After Dott.)

those with mild symptoms that do not come to operation or necropsy, would not be recognized.

Dott,¹ in 1923, published a comprehensive description of the embryology, mechanism and pathology involved, including all clinical phases of the subject. He noted forty-five cases of gross congenital malposition of the midgut in a review of the literature and added five cases of his own.

This condition takes its greatest toll in early infancy, usually a result of high intestinal obstruction. It generally occurs at the duodenocolic isthmus which is situated at the base of the great loop forming the midgut, and

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includes its blood supply, the superior mesenteric artery. This artery is considered the axis around which the midgut rotates during fetal development. The volvulus seems to cause no interference with circulation.

The symptoms point to obstruction in the region of the upper portion of the small intestine, often simulating congenital stenosis of the duodenum, pyloric stenosis, volvulus of a small loop of gut, intussusception, or pressure due to a mesenteric cyst. The presence of bile in the vomitus and the fact that the food is not ejected immediately after being ingested usually points toward obstruction below the pylorus. A successful röntgenogram is of great value.

At operation in infants, for volvulus due to anomalous intestinal rotation, there will be great distention of the stomach, pylorus and upper duodenum. The colon is not apparent and may be found with difficulty. The duodenum may present itself uncovered by the large bowel and having a free mesentery. In non-rotation the duodenum will pass down the right side of the root of the mesentery (as there is no duodenojejunal flexure) and the ascending colon will pass up the left side. In reversed rotation the transverse colon will lie behind the origin of the superior mesenteric artery, and the duodenum in front. The ascending colon will be in its normal situation but there is no duodenojejunal flexure.

In exomphalos the physiological and embryological hernia of the midgut into the root of the umbilical cord has persisted until birth (Dott), and it is not a true umbilical hernia.

At operation in an infant for exomphalos, the extruded bowel illustrates quite vividly the failure to rotate of the midgut. The cæcum here is usually situated in the left side of the abdominal cavity, in almost the reverse of its usual situation at this age, where it is normally found in the right upper aspect. The ileum may occupy the right side of the cavity. Rotation is accomplished manually with ease. In these infants the distribution of the midgut may not change materially after the twelfth week of embryological life.

In volvulus neonatorum early operative interference holds out the only hope of saving life. Dott suggests reduction of the volvulus by delivering the intestinal mass and untwisting, with an approximation of normal conditions. He also suggests artificial fixation by suture of the cæcum and ascending colon to the right loin. If reduction is impossible because of adhesions, gastrojejunostomy may be successful.

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NOTE ON LUDWIG'S ANGINA

Few articles on Ludwig's Angina are to be found in the literature of the past ten years, and scarcely any two of these are in entire agreement as to the surgical procedure to be applied. The condition is, therefore, of sufficient rarity and interest to warrant a discussion of the following case, which occurred recently in the writer's private practice.

Mrs. A. Q., aged twenty-two years, was admitted to the Rochester General Hospital, complaining of swelling in the submental region, three days' duration. According to the history elicited, three weeks prior to admission to the hospital she had developed an impetigo sore on her chin, which persisted in spite of sundry forms of treatment. Three days before admission there appeared a progressively increasing submental swelling, which was considered a lymphadenitis. Shortly after admission the swelling had increased so that movements of the tongue were a little embarrassed. Some twelve hours later she had an acute attack of dyspnoea. The floor of the mouth was now markedly swollen and both submaxillary regions were full, especially the left. Temperature, 101.2; pulse, 110; respirations, 20; white blood-cells, 10,200.

Under local anaesthesia, a vertical incision was made from the chin to the hyoid bone, separating the muscles down to the floor of the mouth; a few drops of pus were obtained on the right side. Through this incision, the shelf formed by the mylohyoid muscles could easily be felt on both sides. A small rubber tube was inserted into each supra-mylohyoid area for purposes of drainage.

During the next twenty-four hours all of the patient's symptoms became much worse—viz., difficulty in breathing and swallowing, swelling in the submaxillary region, and swelling of the tongue and of the floor of the mouth. Under local anaesthesia, incisions were then carried laterally from the vertical incision to divide both geniohyoids, both anterior digastrics, and both mylohyoid muscles. Only a few drops of pus were obtained. Following this procedure, the patient made a very satisfactory convalescence. The oedema in the mouth and neck began to subside in about twenty-four hours. She was discharged on the fourteenth day.

The foregoing case presented several unusual features: (1) In its pathogenesis—practically every case recorded has arisen from an internal source, such as a carious tooth following tooth extraction; an ulcerated oral mucous membrane; a fractured mandible; and occasionally an angina, or a quinsy. The source of this case, however, was an infected lesion of impetigo contagiosa on the chin. In the usual case—with an internal focus—the submaxillary lymph-glands, since they drain the oral cavity, are the first group involved. But in this case—with its external focus—the initial development was an acute lymphadenitis in the submental region—with the process finally extending through the mylohyoid diaphragm to involve the loose connective tissue in the floor of the mouth; *i.e.*, to the development of a *true* Ludwig's Angina.

(2) The insufficiency of the first operation demonstrated that it is a misconception to believe that one has simply to open or perforate the diaphragm formed by the two mylohyoid muscles, and that then the supra-mylohyoid space can be drained. In the case here reported, it was found that the two tubes so inserted did *not* drain, and that their presence actually increased the tension on the floor of the mouth, so that clinically the patient was not improved.

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(3) The sufficiency of the second operation was due to a proper conception of Ludwig's Angina, based upon a study of the anatomy of the region and of the pathological conditions present.

Anatomical Considerations.—In reviewing the anatomy of the region, stress should be given to the character and relationships of the mylohyoid muscle. This muscle forms a floor for the cavity of the mouth, a diaphragm covered by dense fascia superficially, which acts as a distinct barrier to the extension forward and externally of any infection in the floor of the mouth. It arises from the mylohyoid ridge of the mandible and extends from the symphysis in front to the last molar tooth behind. The posterior fibres pass inward and slightly downward, and are inserted into the body of the hyoid bone. The middle and anterior fibres are inserted into a midline raphe. The relations of the mylohyoid muscle are given as follows: by its superficial surface—with the platysma, the anterior belly of the digastric, the suprahyoid aponeurosis, the submaxillary gland, submental vessels, and mylohyoid vessels and nerve; by its deep surface—with the geniohyoid, part of the hyoglossus and styloglossus muscles, the hypoglossal and lingual nerves, the submaxillary ganglion, the sublingual gland, the deep portion of the submaxillary gland and duct, the sublingual and ranine vessels, and the buccal mucous membrane.

Pathological Considerations.—At the time of operation there is usually no abscess. Only a few drops of pus, if any at all, are seen—occasionally in the submental region, but more commonly in the submaxillary region. What is present is a tense œdema. The patient's symptoms undoubtedly cannot be accounted for by the œdema superficial to the diaphragm of the mylohyoids. What does push up the patient's tongue, thus causing the mechanical symptoms, is the marked œdema of the loose cellular tissue in the floor of the mouth—i.e., on the oral side of the mylohyoid diaphragm. It is this pressure that must be released.* Here, then, is the crux of the surgical treatment of Ludwig's Angina: it is not incision and drainage that is most important, but rather release of pressure. For this reason, I now favor a long transverse incision of the mylohyoid diaphragm, extending laterally on each side almost throughout its entire breadth. For the same reason, I also favor the simple horizontal incision of the skin parallel with and one finger's breadth below the jaw.

Several authorities recommend incision of the submaxillary salivary gland or opening of its external capsule in all cases. Dr. E. Rehn, of Freiburg, recently recommended total extirpation of the submaxillary salivary gland, on the side primarily involved, as a means of preventing extension of the process posteriorly to the carotid sheath and thence down the fascial planes to the mediastinum. In the case reported above, no such radical surgery was necessary.

* The author is indebted to Dr. H. L. Prince for a personal communication substantiating this conclusion.

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BOOK REVIEW

TROPICAL SURGERY AND SURGICAL PATHOLOGY, by Karuna K. Chatterji. New York, William Wood and Company, 1927. Octavo, cloth, pages 244. Freely illustrated.

Sir Havelock Charles, in an appreciative foreword, says that this book is the first of note that has been brought out on Tropical Surgery. If this is true, and the reviewer knows nothing to the contrary, the book occupies a position of unusual importance, especially at this time when by the improved means of communication that the world enjoys, all parts of the world are made akin. The author himself points out the diffusion of tropical diseases which has resulted from the Great War, thus increasing the importance of the familiarity upon the part of western surgeons with diseases which formerly had been felt to be peculiarly the province of surgeons practicing in the east and in the tropics. The book itself is primarily a British publication republished in America with a New York imprint.

According to the author, India is an epitome of the world. Here one finds the coldest and hottest climates and all degrees of humidity and moisture. The student who looks for materials for the study of tropical surgery and pathology finds India the ideal country. The author states that the European can easily maintain good health in the tropics by prudence and attention to clothing, suitable food and beverages, avoidance of chills, over-exercise, late rich dinners, and dinner parties. There are, however, many surgical conditions common in the tropics and peculiar to it which are of infective origin. It is the diffusion of these infections which are related to the diseases of tropical origin diffused by the Great War.

The author is of the opinion that operative hazards are generally greater in the tropics than in temperate climates. Chloroform is the standard anæsthetic according to the author. With proper precautions regarding purity, preparation of the patient and after-treatment, he thinks it safe and useful, particularly in the absence of skilled anæsthetists.

Naturally, the first place and the greatest space in the book is given to the consideration of amœbiasis in its various manifestations and particularly those due to *entamoeba coli* and *entamoeba histolytica*. This section includes the first ten chapters and is of great interest and positive value. Next in order comes the subject of filariasis to which eight chapters and sixty pages are devoted. The various forms of lymphatic obstruction and their results in all parts of the body are treated seriatim. The well-known forms of elephantiasis render this section of the book particularly striking. Then follows a section on tropical granulomata including the Maduro foot, Yaws,

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the Delhi boil, tropical ulcer and others. The author's remarks upon all these conditions are very informing and will command the interest and increase the knowledge of the reader.

The style of the author, as a whole, is simple and straightforwardly descriptive and commends itself to the reader. The writer is telling what he has seen, what is his individual experience, so that a personal interest is sustained from the beginning to the end of the book. We commend it unreservedly.

LEWIS S. PILCHER.

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